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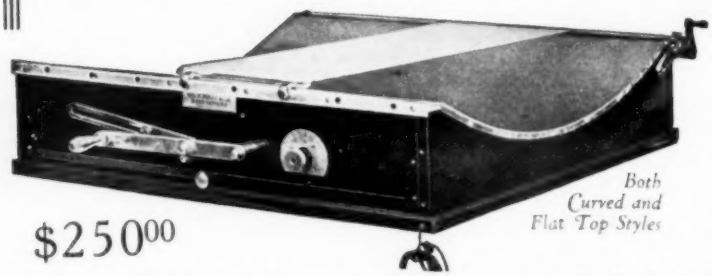

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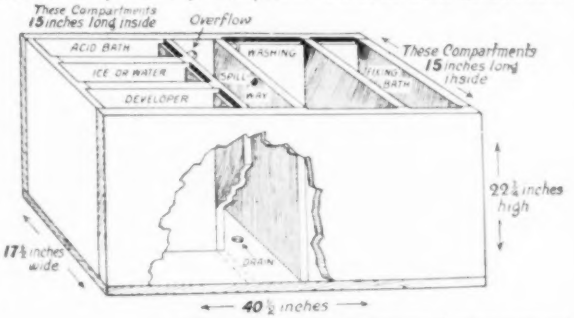

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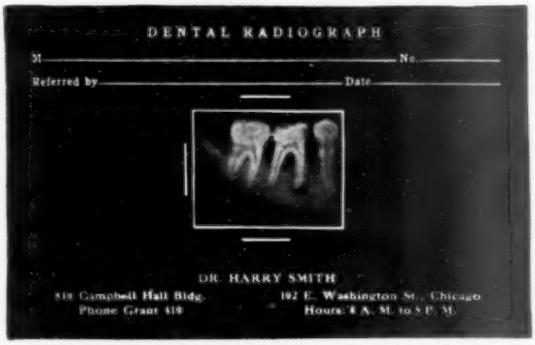

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THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. XVIII JULY, 1927 NO. 1

THE EFFECT OF A CASTRATION DOSE OF ROENTGEN RAYS UPON THE RABBIT OVARY

AN EXPERIMENTAL STUDY WITH A CLINICAL EVALUATION OF THE PROBLEM OF OVARIAN IRRADIATION*

BY M. R. ROBINSON, M.D., F.A.C.S.

NEW YORK CITY

I. INTRODUCTION

WITH the advent of the biologic era in radiotherapy, the treatment of dysfunctions became as important a problem as the therapy of benign and malignant neoplasms. In the fields of gynecology and obstetrics the following questions absorb our attention: (1) Is temporary castration a justifiable and safe procedure? (2) What effect has a preceding ovarian castration upon subsequent conceptions, pregnancies, and the offspring? (3) When is the offspring most affected by ovarian irradiation? (4) Is the so-called ovarian stimulation therapy a direct radiation effect?

Many investigations of an experimental and clinical nature were undertaken to solve these problems, and while much of definite knowledge has been acquired, a great deal of confusion still exists. The main reasons for the persistence of this fear, doubt, and uncertainty are: (*a*) The anatomic and physiologic complexities of the ovary; (*b*) the difficulty of interpreting functional disorders in terms of histopathology; and (*c*) the lack of uniformity in the experimental methods employed. I shall consider these facts seriatim.

The ovary is not only elaborating internal secretions which inhibit the pituitary, the thyroid, and the adrenals, thus regulating the vasomotor, the somatic and the psychic balances in the female, but it also plays a very important rôle in the process of reproduction. The latter function is associated with local and general changes of a marked nature, and as a result of this dual function which is constantly going on in the ovary during the entire reproductive life of the female, its structure and activity are forever in a state of flux, either in the ascending or the descending scale.

To interpret accurately, therefore, the effects of radiant energy upon the function of the reproductive gland, in terms of morphology as noted after irradiation, it would be most desirable to carry out the experiments along the following lines: (*a*) An exposure of the ovary to a definite quantity and quality of radiant energy, during the different phases of its activity, and (*b*) a histopathologic, and if possible, also a biologic study, of the ensuing changes, as they occur at precisely stated periods after the irradiation. Such a method of investigation would be in full harmony with the most modern teachings of biophysics which state that the tissue reactions following irradiation are dependent not only upon the amount and the variety of rays used, but also to a very

* To Dr. Wm. Kalbfleisch, my associate in radiotherapy, I wish to express my sincere thanks and appreciation for the valuable aid he has rendered me in carrying out these experiments.

large extent upon the biologic state of the tissue in question, at the time of the exposure. The more modern interpretation of the Bergonié-Tribondeau law embodies the second of the two biologic principles mentioned above. It postulates: "The more labile the kinetic state of a tissue, the greater is its radiosensitiveness; and inversely, the more stable the kinetic state, the less is its response to the effects of irradiation." I regret to note that in one of the latest American contributions to the subject of ovarian irradiation by Matthews this biologic principle has been ignored, for the author states: "The effects of X-ray and radium upon tissues in general are essentially identical, depending in all instances upon the 'dose' administered."

For self-evident reasons, it is impossible to carry out this ideal plan of study in the human species; and in the lower animals we meet with another obstacle, namely, the uncertainty (in many species) of the periodicity of the estrus, and the difficulty of detecting its onset by inspection. In view of these difficulties the present contribution is limited to the histopathologic study of irradiated ovaries, and the effects of irradiation upon their function. This method, however, still leaves a scientific gap, for the mere morphologic study fails to reveal those finer biochemical changes induced by the rays, and which are undoubtedly the precursors of the later structural alterations. To reduce therefore this hiatus to its narrowest dimensions, the irradiated ovaries should be studied in a systematic fashion at more frequent intervals after exposure.

It can be seen quite readily that the information gained from such a plan of inquiry will bear upon (*a*) the radiosensitiveness of the ovary; (*b*) the differences in radiosensitiveness between its different components; (*c*) the period of highest susceptibility, and (*d*) the timely variations in the effects of the radioactive substance.

To insure still further accuracy in biologic deductions formulated from histopathologic studies of irradiated ovaries (or, for that matter, of any other tissue or organ), we must also avoid the error so often committed, of subjecting the ovary to different doses of radiant energy and then grouping the resulting reactions under one heading. We have to bear in mind that just as different tissues, or the same tissue at different states of its kinetic energy will react differently to the same dose of roentgen rays or radium, so will different doses of a radioactive substance produce different effects in the same tissue under the same biologic conditions. For the sake of clarity, I shall enumerate the factors which enter into a roentgen biologic experiment. (1) The age of the subject; (2) the state of health; (3) the functional state of the organ or tissue at the time of the exposure (if it can be ascertained); (4) the interval between the irradiation and the removal of the tissue for microscopic study; (5) the dose of radiant energy employed, which embraces a consideration of voltage, milliamperage, filtration, focus

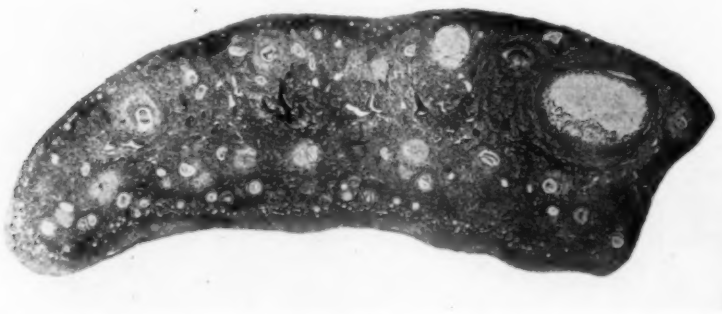


Fig. 1. Ovary of a virgin rabbit one week after exposure to a castration dose of roentgen rays. The outstanding feature is an increased degeneration of ova in the secondary and the tertiary follicles (19×).

skin distance, size of irradiated field, and the time of exposure.

With this brief introduction to the study of the effects of radiant energy upon organic function in general, I shall proceed to the presentation of my thesis.

II. THE EXPERIMENTS

Chart 1 contains all the physical and biologic data underlying these experiments, and I wish only to add that all the animals were kept under the most favorable conditions, and that during the irradiation they were tied down to the usual board employed in laboratories, by their extremities, which insured perfect quiet during the exposure.

CHART 1

EXPERIMENTAL DATA

Physical factors

200 kv.; 2 ma.; Filter 0.5 mm. Cu + 4 mm. Al.; F.S.D. 23 cm.; Field 6 × 8 cm.; 170 per cent of the S.E.D. (Seitz); Time of exposure 68 min.

Biologic factors

No. of Exper.	No. of Rabbit	Age	Date of Irradiation	Date of Removal of Ovary	Surface Irradiated	Remarks
1	1	6-8 weeks	3 11 1924	3 18 1924	Lumbo-sacr.	
2	2	6-8 weeks	3 11 1924	3 25 1924	Lumbo-sacr.	
3	3	6-8 weeks	3 12 1924	4 2 1924	Lumbo-sacr.	
4	4	6-8 weeks	3 12 1924	4 10 1924	Lumbo-sacr.	
5	5	6-8 weeks	3 12 1924	4 16 1924	Lumbo-sacr.	
6	6	6-8 weeks	3 12 1924	4 24 1924	Lumbo-sacr.	
7	1	6-8 weeks	3 11 1924	4 30 1924	Lumbo-sacr.	Left ovary removed, complete epilation of irradiated area
8	7	Six mos.	.....	11 25 1924	.....	Left ovary removed. Gravid with six fetuses each 1 cm. in diameter.
9	7	Six mos.	11 20 1924	3 2 1925	Lumbo-sacr.	Right ovary removed, no evidences of pregnancy, fetuses absorbed.

III. THE HISTOPATHOLOGY OF THE IRRADIATED OVARIES

1. *The Ovary of a Virgin Rabbit One Week after Irradiation with a Castration Dose of Roentgen Rays* (Fig. 1). Comparing this ovary with that of a non-irradiated organ of the same age, there are hardly any variations to be noted. Under a higher magnification (Fig. 2) the germinal epithelium is distinctly seen, the stroma is composed of its characteristic spindle-shaped connective tissue cells, densely arranged in the cortex and somewhat more loosely towards the medullary portion. The interstitial cells form a small part of the intergenerative system, but they are nevertheless well formed, they have an epithelioid appearance resembling corpus luteum cells of the human ovary; and are grouped either in the form of strands separated by fine septa of ovarian stroma, or as small clumps scattered throughout the organ, but preponderately near and around the maturing follicles. The generative part presents the usual constituents, primary, secondary and tertiary follicles. The primary follicles are numerous, located mainly in the cortical portion, lined with a single layer of endothelial-like cells, the protoplasm is finely reticular and takes on a pinkish color, and the ovule is stained blue. The secondary follicles are much larger, located somewhat more centrally, their lining epithelium is

columnar, the follicular cavity is filled with a fine fibrillar texture which encloses a round or irregular hyaline pinkish body representing a degenerated ovule; in others, the ovule is missing and a vacuolated space is left. The tertiary follicles show full ripening characterized by a well-formed membrana granulosa and the presence of the cumulus, but the ovule is missing in most of them. No corpora lutea are seen.

Comment. With the exception of ovular degeneration in some of the secondary and most of the tertiary follicles no other structural change is noted. This type of degeneration, while present to a moderate degree in non-irradiated ovaries, representing the end-results of incomplete ovulations, is not so extensive as observed one week after irradiation.

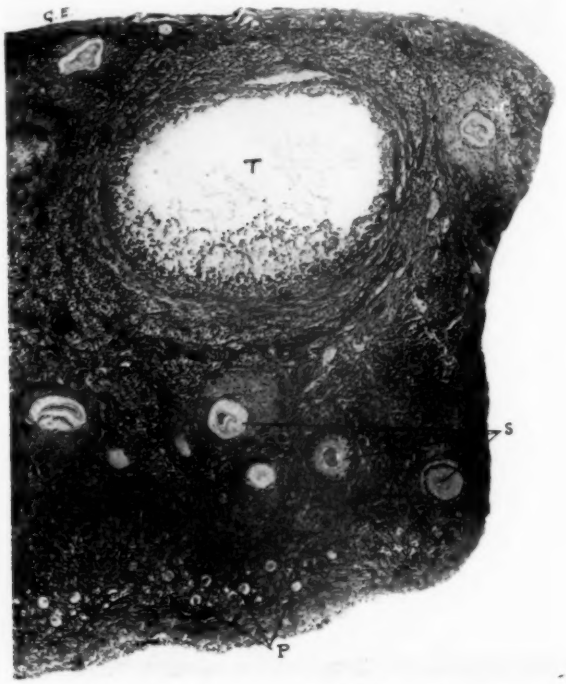


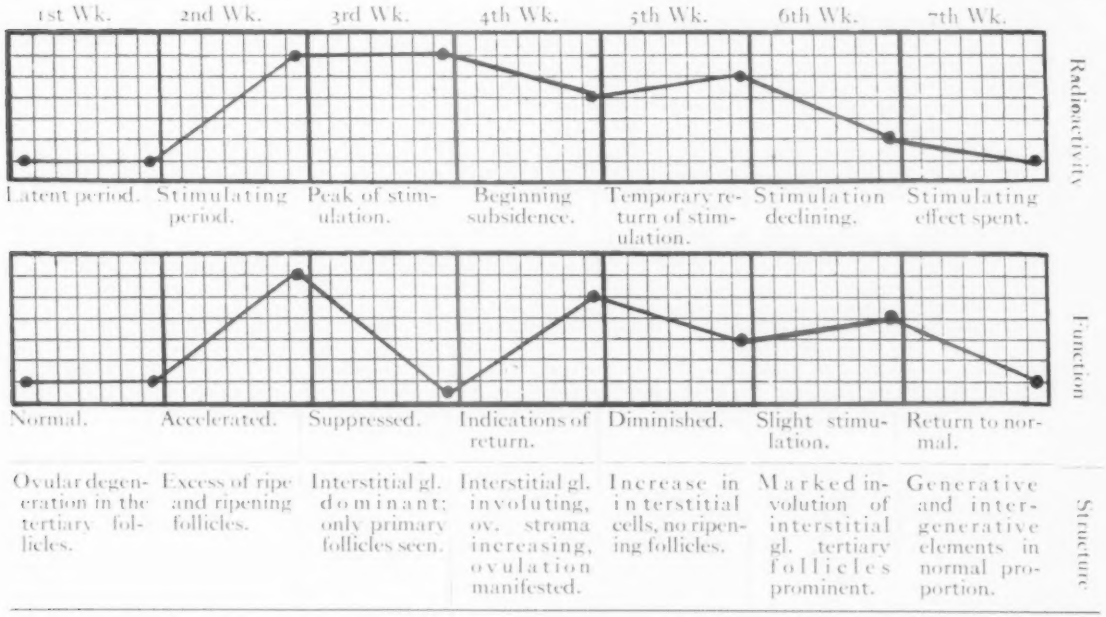
FIG. 2. A high power study of Figure 1. The germinal epithelium is retained (G.E.); the primary (P), the secondary (S) and the tertiary (T) follicles are normal in appearance, in numerical relationship, and in proportion to the ovarian stroma. The ova show a greater amount of hyaline degeneration than that present in non-irradiated organs. The interstitial cells (I.C.) present an epithelioid character. No corpora lutea.

2. *The Ovary of a Virgin Rabbit Two Weeks after Roentgen Castration* (Fig. 3). The ovary is somewhat smaller in size and the number of tertiary follicles has increased. A higher power study (Fig. 4) shows an absence of the germinal epithelium; most of the primary follicles have disappeared, only a faint outline of some is still discernible. The secondary follicles contain either degenerated ovules or none at all, and some are filled with proliferated epithelium; the tertiary follicles are quantitatively and qualitatively in ascendency, and contain well-developed cumuli and membrana granulosa layers, but the ovules are missing or are degenerated. The ovarian stroma is somewhat reduced in quantity due to a moderate increase in interstitial cells.

Comment. From the morphologic appearance of this ovary we may state that by the end of the second week after castration the effect of the roentgen rays was of an irritative or stimulating character, for it hastened the process of ripening in many of the follicles, but destroyed the ovules. Some of the tertiary follicles show cystic degeneration. Simultaneously with this increased ovulation there is also noted a

CHART II

A SYNTHETIC CHART OF THE RADIOACTIVE, THE FUNCTIONAL AND THE STRUCTURAL PHENOMENA OCCURRING SIMULTANEOUSLY IN A ROENTGEN CASTRATED OVARY OF A VIRGIN RABBIT AS OBSERVED AT WEEKLY INTERVALS



suppression of function in the primary follicles, for they can hardly be seen.

3. *The Ovary of a Virgin Rabbit Three Weeks after Exposure to a Castration Dose of Roentgen Rays* (Fig. 5). The ovary appears larger than the one removed at the end of the second week after castration. We note a very marked reduction in the quantity of ovarian stroma, which is reduced to a narrow cortical strip, harboring once more primary and secondary follicles; the rest of it is displaced by an excess of interstitial cells. Of the tertiary follicles only two are seen in the entire section, and both of them are in a state of cystic degeneration. A higher magnification (Fig. 6) shows a reappearance of germinal epithelium in some parts of the circumference. The primary follicles are again in evidence, many of them are lined with endothelial-like cells and contain normal looking ovules. The secondary follicles are filled with proliferated epithelium, but no eggs; the tertiary follicles are wanting, only their remains in the form of irregular hyaline clumps, lying scattered between

FIG. 3. Ovary of virgin rabbit two weeks after exposure to a castration dose of roentgen rays. It shows a perceptible diminution in size when compared to the ovary removed one week after irradiation with a similar dose; a marked diminution in the number of primary follicles, a reduction in the number of secondary follicles; but a pronounced increase in tertiary follicles (18×).

the interstitial cells are seen; the few tertiary follicles whose outlines are still discernible, are cystically degenerated. The interstitial cells show a well-developed pearance of normal primary follicles. All these structural changes simulate those taking place in the normal ovary during the pregravid state. The unfolding of the

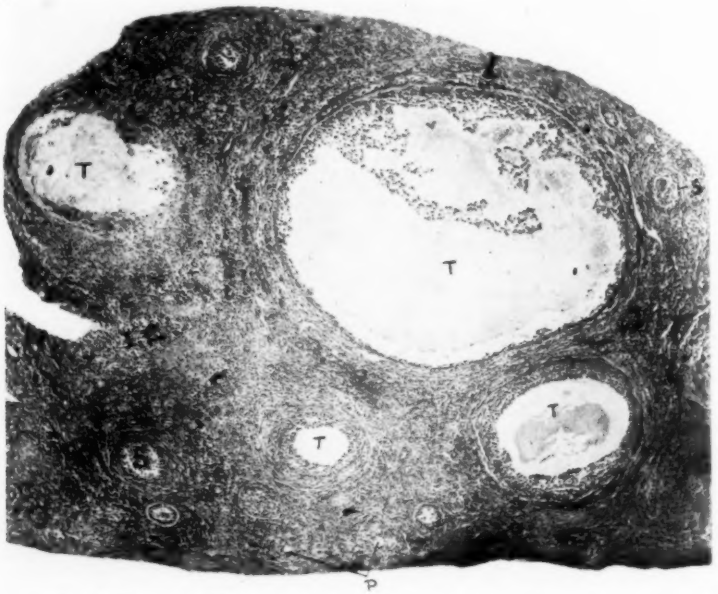


FIG. 4. A high power study of Figure 3. The germinal epithelium is wanting; only traces of the primary follicles (P) are seen; the secondary follicles (S) contain degenerated ova, or their lumina are filled to capacity with proliferated epithelial cells; the tertiary follicles are in excess, ripe and ripening with degenerated ova. Moderate decrease in ovarian stroma, and an increase in interstitial cells.

epithelioid character with distinct nuclei and cell bodies, arranged for the most part in lobular formation.

Comment. The striking morphologic facts are: the predominance of interstitial sterilizing effect of the roentgen dose is shown by the complete destruction of the tertiary follicles, and the removal of their inhibitory effect upon the interstitial gland or corpus luteum; the latter has

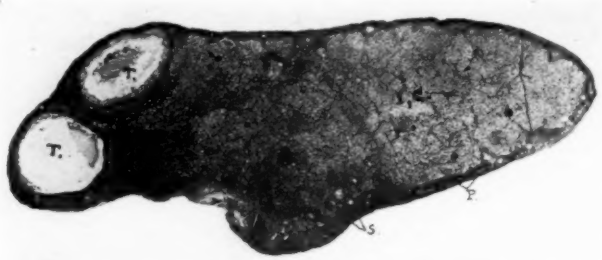


FIG. 5. Ovary of a virgin rabbit three weeks after an exposure to a castration dose of roentgen rays. The interstitial gland (I.G.) forms the major part of the ovarian stroma; the latter has been reduced to a narrow cortical strip, containing once more primary (P) and secondary (S) follicles. Only two tertiary follicles (T) are seen in the entire section, and both are cystically degenerated (18×).

gland substance, the reduction of ovarian stroma, the absence of tertiary follicles and cystic degeneration of those still recognizable, the presence of secondary, and a reap- therefore grown to full proportions, and has in turn kept ovulation in check. Although many primary follicles have come again to the fore, they are quiescent, and the secon-

dary follicles show very little activity. These structural phenomena permit of the deduction that the disappearance of the primary follicles from the irradiated ovary at a period when the stimulating effect makes itself evident by the increase of ripening follicles, should not be interpreted as a destruction, but as a temporary displacement.

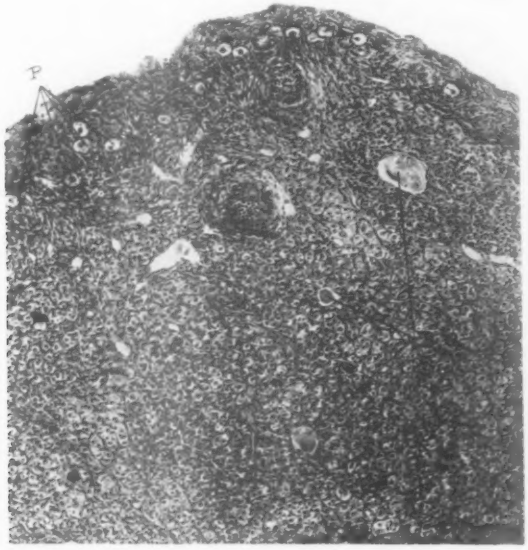


FIG. 6. High power study of Figure 5. The interstitial cells (I.C.) resemble those of the corpus luteum, and form the major part of the ovarian stroma. The latter is seen very distinctly in the cortical zone; it harbors many normal primary follicles (P). The secondary follicles (S) are filled with proliferated granulosa epithelium. Only the blighted ova (B.O.) in a state of hyaline degeneration are all that is left of the tertiary follicles.

tative loss. The latter is broken up into smaller and irregular lobes by the encroachment of strands of ovarian stroma. The generative elements show a numerical and functional gain, for we note tertiary follicles ripening and containing normal ovules.

Comment. The radioactivity must be on the wane, for the ovarian function is returning as shown by the involution of the interstitial gland and resumption of follicular activity.

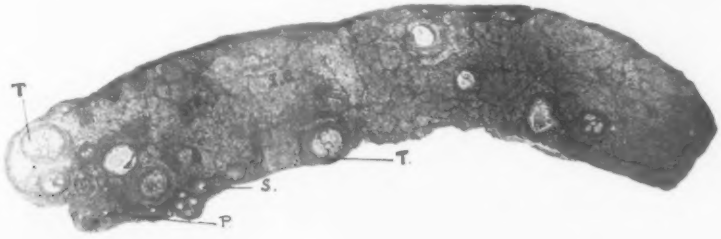


FIG. 7. Ovary of virgin rabbit four weeks after exposure to a castration dose of roentgen rays. Ovarian stroma (STR) presents a greater proportional relationship to the generative system, which shows primary (P), secondary (S), and tertiary (T) follicles in a normal state of activity. The interstitial cells show a quantitative reduction (10×).

4. *The Ovary of a Virgin Rabbit Four Weeks after an Exposure to a Castration Dose of Roentgen Rays* (Fig. 7). The ovarian stroma shows a considerable increase and the interstitial gland a quanti-

5. *The Ovary of a Virgin Rabbit Five Weeks after Exposure to a Castration Dose of Roentgen Rays* (Fig. 8). The inter-

stitial gland shows once more a quantitative advance, and the generative elements a recession. A higher power study (Fig. 9) shows very few active tertiary follicles, a reduction in ovarian stroma, and an increase in interstitial cells. In some parts the left third of the section the ovarian stroma contains very few interstitial cells. The follicular apparatus is represented by all of its three constituents, and ovulation is in progress.

Comment. The ovarian structure and

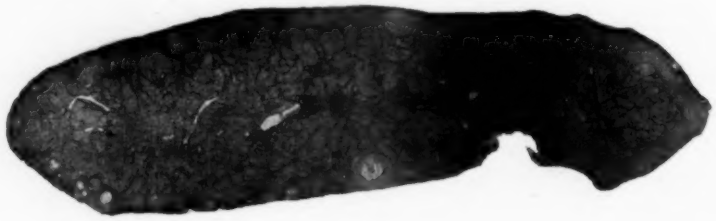


FIG. 8. Ovary of virgin rabbit, five weeks after exposure to a castration dose of roentgen rays. There is an increase of interstitial gland substance, in comparison with Figure 7, and a reduction of ovarian stroma proper. The generative elements also show a numerical and functional decrease (19×).

the section shows fibrotic nodules, most likely corpora fibrosa.

Comment. There is an apparent renewed radioactivity, indicated by an inhibition of follicular activity, and an enhancing of interstitial cell formation; the function show an approach much nearer to the normal state.

7. *The Ovary of a Virgin Rabbit Seven Weeks after Exposure to a Castration Dose of Roentgen Rays* (Fig. 11). The generative part of the ovary presents a

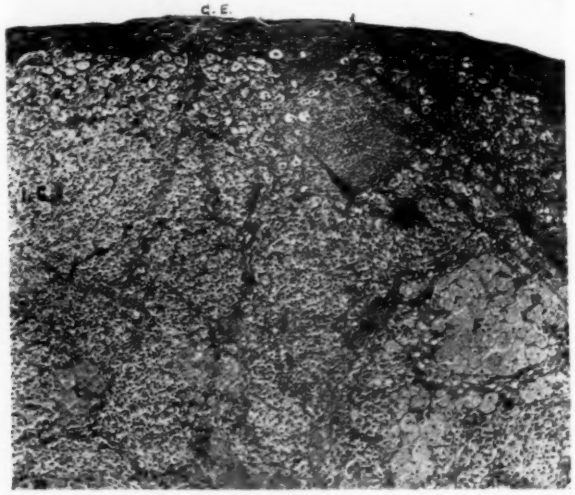


FIG. 9. A high power study of Figure 8. Marked reduction of ovarian stroma (S) which is seen chiefly in the cortex, and in the form of strands between the interstitial cells (I.C.). Some corpora fibrosa (F) are also seen. The germinal epithelium (G.E.) stands out prominently on the surface.

reasons for this deviation from the expected course will be explained later.

6. *The Ovary of a Virgin Rabbit Six Weeks after Exposure to a Castration Dose of Roentgen Rays* (Fig. 10). The interstitial gland is involuting progressively, and the ovarian stroma increasing. In normal appearance; and the ovarian stroma is also regaining its quantitative proportions; in some parts of the section the interstitial cells have disappeared completely.

Comment. At this time, the end of the seventh week after castration, the radio-

activity is exhausted, and the ovary presents a normal picture. The hemorrhagic degeneration noted in the tertiary follicles in the upper part of the section may be the result of the previous irradiation, but I am inclined to the belief that it is a phenomenon observed at times in non-irradiated organs as well.

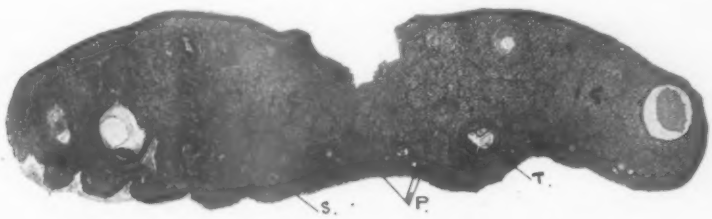


FIG. 10. The ovary of a virgin rabbit six weeks after an exposure to a castration dose of roentgen rays. The primary (P), the secondary (S), and the tertiary (T) follicles show a numerical and functional increase. A further reduction in the amount of interstitial gland substance (I.G.) and a gain in ovarian stroma (O.S.) (19×).

8. *The Ovary of a Six Months Old Rabbit Gravid with Six Ova* (Fig. 12). Of the intergenerative elements the interstitial cells form the main constituent, and in the upper left quadrant of the section a corpus luteum of pregnancy is seen. The normal ovarian stroma is reduced to a very small proportion. The generative parts show very few primary, some secondary, and a fairly large number of tertiary follicles. The last forming the corpus luteum do not differ in appearance from the interstitial cells except in being somewhat larger. The ovarian stroma is normal in structure but sparse in quantity. The primary follicles are few and resting; the secondary follicles show some activity, and the tertiary are either fully ripe with normal ovules, or in a state of cystic degeneration.

FIG. 11. The ovary of a virgin rabbit seven weeks after roentgen castration. The generative elements present a structural and numerical return to normal, and in the right and lower parts of the section the ovarian stroma is almost free of interstitial cells, the latter are being crowded out (18×).

Comment. In many respects this ovary of pregnancy simulates the generative gland of a non-gravid rabbit at the end of the second and beginning of the third

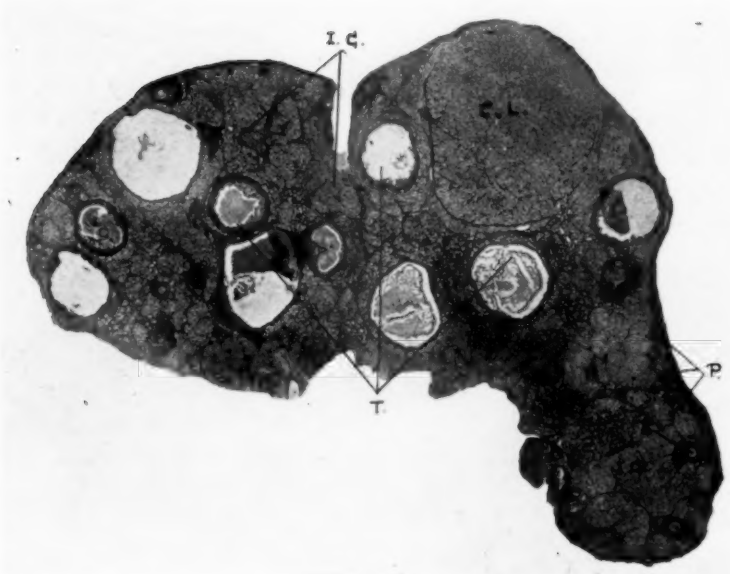


FIG. 12. Ovary of a six months old rabbit gravid with six ova. The interstitial gland predominates (I.G.); in the right upper quadrant a corpus luteum (C.L.) of pregnancy is seen; the ovarian stroma proper is reduced to a marked degree. The tertiary follicles (T) show an acceleration of activity, some contain normal ovules, others are cystically degenerated; the secondary follicles (S) are active; the primary follicles (P) are crowded out towards the cortex and are resting (18×).

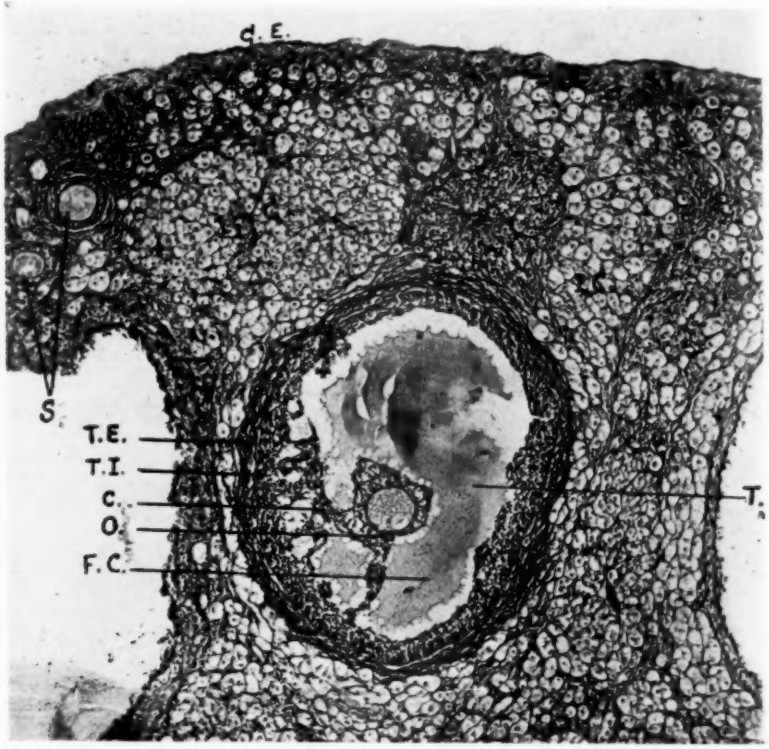


FIG. 13. A high power study of Figure 12. The germinal epithelium (G.E.) is well seen on the cortex. The stroma ovarii (ST) forms a narrow cortical strip with prolongations into the ovarian substance, which consists largely of interstitial cells (I.C.). Hardly any primary follicles; a few well developed secondary follicles (S), and fully mature tertiary follicles (T) showing a theca externa (T.E.), a theca interna (T.I.), a cumulus (C), an ovule, and a follicular cavity (F.C.).

week after exposure to a castration dose of roentgen rays. In both of them we note a stimulation of the ripening process in

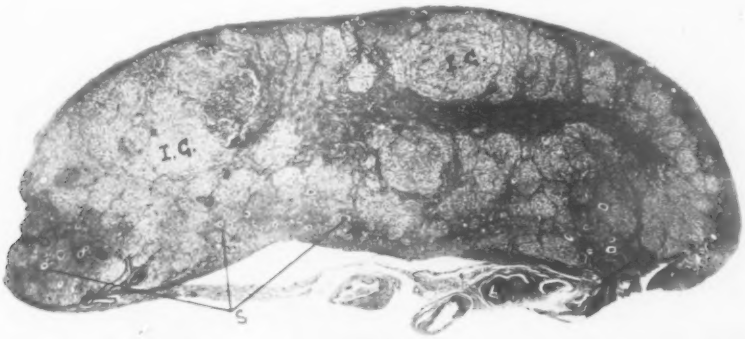


FIG. 14. Ovary of a six months old rabbit, gravid with six young at the time of the exposure, three months after the roentgen castration. The interstitial gland (I.G.) substance is broken up into smaller lobules by the encroaching band and septa of ovarian stroma (ST). Absence of tertiary follicles; and dark staining irregular masses fill the follicular cavities of the secondary and perhaps also of the contracted tertiary follicles. A faint outline of germinal epithelium is seen on the surface to the extreme left (18×).

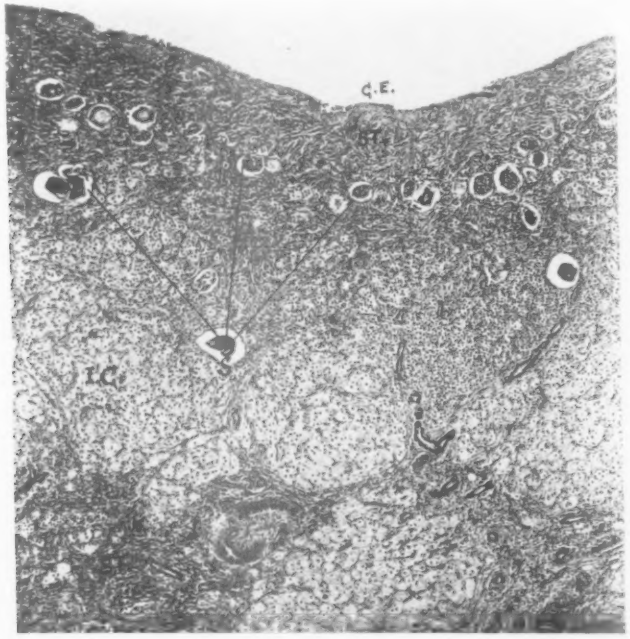


FIG. 15. A high power study of Figure 14. Note the remnants of germinal epithelium (G.E.). The increase of ovarian stroma (ST) both in the cortical and medullary portions. No tertiary follicles; the follicular cavities are filled with hemorrhagic clumps, the degenerated ova, or with masses of broken up epithelial cells. No primary follicles. The interstitial cells are compressed, and in some parts so closely that only the nuclei are seen, giving the impression of a round cell infiltration.

presents a degeneration of all ripening eggs. This fact marks the vital biologic difference between the physiologic stimulation of ovarian hormones and the artificial stimulation of the radioactive substance.

the tertiary follicles, a displacement of the primary follicles, and an excess of interstitial cells. The outstanding exception is that the non-irradiated organ contains normal ovules, while the irradiated ovary

9. *The Ovary of a Six Months Old Rabbit Gravid with Six Young Three Months after Roentgen Castration* (Fig

TABLE I

DEFECTIVE CHILDREN BORN TO MOTHERS IRRADIATED BEFORE CONCEPTION

Year	No. of Cases	Roentgen Rays	Radium	Author	Source	Character of Defects	Indications for the Irradiation
1920	1	x	..	Heimann	Strahlentherapie, xi, 731.	Child three years of age, pale looking, otherwise normal.	?
1920	2	x	..	Pankow, H. A.	Strahlentherapie, x, 1011.	At the age of three is pale looking, rachitic, mentally normal.	?
1923	3	..	x	Bailey & Bagg	Am. J. Obst., v, 461.	Malformation of head, hernia cerebri, died eleven hours after birth.	Mother treated on several occasions with large doses of radium for Hodgkin's disease.
1925	4	x	..	Thaler	Centralbl. f. Gyn., xlii.	Congenital heart malformations.	Gave birth to a normal child one year later.
1925	5	x	..	Gummert	Arch. f. Gyn., cxxv, 607	Mongolian idiot, born two years after irradiation.	Fibroids with metrorrhagia.
1926	6, 7, 8, 9	x	..	Martius, H.	Strahlentherapie, xxiv, 101	Between the ages of three and five they were undersized, otherwise normal.	
1926	10–13	x	..	Martius, H.	Strahlentherapie, xxiv, 101.	Were rachitic.	
1926	14	x	..	Martius, H.	Strahlentherapie, xxiv, 101.	Very delicate.	
1926	15–17	x	..	Martius, H.	Strahlentherapie, xxiv, 101.	Died between the ages of one and two from intercurrent diseases.	
1926	18	x	..	Martius, H.	Strahlentherapie, xxiv, 101.	Had tremors, not due to any organic lesion, otherwise normal.	
1926	19	x	..	Martius, H.	Strahlentherapie, xxiv, 101.	At the age of three staggering gait, no recognizable organic lesion.	

14). The organ as a whole is smaller than the left ovary removed from the same animal three months previously, just before the irradiation. We still note that the interstitial gland (I.G.) substance forms the major component of the ovarian stroma (ST), the latter being represented by narrow strips in the cortex as well as in the medullary portions of the ovary. There are no tertiary follicles, but many follicular spaces containing dark-staining irregular masses. A faint outline of some secondary follicles (S) is recognizable particularly in the cortical portion, where some primary follicles may also be seen, but which do not appear to be normal. A higher power study (Fig. 15) shows a definite hemorrhagic degeneration of almost all of the ovules, which lie in follicular cavities as shrunken and distorted clumps, separated from the follicular limiting membrane by a clear space. Other follicular spaces are filled with broken up epithelial cells. Toward the cortical portion a few secondary follicles still show an intact epithelial lining. The interstitial cells have lost their clear outlines, and they are crowded together by the encroachment of connective tissue bands. Toward the cortical zone the compression of these cells is so marked that their body outlines are totally lost, and their nuclei lie so near each other as to give an impression of a round cell infiltration.

Comment. The destruction of all the follicles in the ovary of a pregnant rabbit,

TABLE II

NORMAL AND ABNORMAL CHILDREN BORN TO MOTHERS IRRADIATED DURING PREGNANCY

Year	Case Number	Roentgen Ray	Radium	Month of Pregnancy	Author	Source	Result				Character of Defect	Remarks
							Full Term	Premature	Abort.	Still Birth		
1914	1	x		1½	Edelberg	Munchen. med. Wchnschr. 2°, 1014.	x				None.	
1914	2		Applied repeatedly	From 1st to 7th	Laquirier et Labelle	Quoted by Driessen.		7th m.			None.	
1915	3	x		3rd	Stern, S.	Am. J. Obst.	x				None.	
1915	4	x		4th	Frankel	F. d. Roentg.	x				None.	
1916	5	x		3½	Koblank	Berl. Klin. No. 5.					None.	
1916	6	x		5th	Imbert	F. d. Roentg.	x				None.	
1916	7	x		4th	Faber	F. d. Roentg.	x				None.	
1917	8	x		2½	Sangemeister	Munchen., med. Wchnschr. No. 36.	x				None.	
1918	9	x		6th	Kohler	Centralbl. f. Gyn. p. 397.	x				None.	Died on the twenty-fifth day.
1918	10	x		2d	Werner, P.	Centralbl. f. Gyn.	x				None.	
1918	11	x		Early	Noujaks, H.	Monatschr. f. Geb. u. Gyn., lxviii.	x				Microcephalus, undersized motor instability.	Subsequent child was normal.[4]
1920	12	x		1st	Aschenheim, E.	Arch. f. Kinderheilk.		8th m.			Microcephalus, mogoloid, convulsions.	Delivered with forceps.
1920	13	x		1st	Werner, P.	Arch. f. Gyn., cxxix, 167.		8th m			Mongolian idiot, microcephalus.	Observed to the age of five.
1921	14	x		4th	Zweifel, E.	Strahlentherapie, xii, 149.	x				None.	
1921	15	x		2d	Albrecht	Munchen. med. Wchnschr.	x				None.	
1921	16	x		3d	Werner, P.	Munchen. med. Wchnschr., xxv.	x				None.	At the age of ten.
1921	17	x		2½	Werner, P.	Munchen. med. Wchnschr., xxv.	x				None.	At the age of – yrs. and 10 mos.
1922	18		x	?	Schweitzer	Quoted by Driessen Strahlenther. xvi, 680.	x				None.	Mother ca. cervix.
1922	19 & 20	x		?	Potocki	Quoted by Driessen Strahlenther. xvi, 680.	x				None.	
1922	21		x	?	de Rouville	Quoted by Driessen Strahlenther. xvi, 680.		6th m.			Died soon after birth.	Ca. of cervix.
1922	22		x	?	Fougere	Quoted by Driessen Strahlenther. xvi, 680.	x				None.	
1922	23		x	6th to 7th	Berkley	J. Obst. & Gyn. Brit. Emp., xxviii, 538.	x				Two bald spots on head which disappeared later, otherwise normal at the age of 8.	Ca. of cervix delivered by Cesarean section.
922	24		x	6th	Field, C. E.	Am. J. Roentgenol.		–½			None at the age of three.	Ca. of cervix.
923	25	x		3d	Stettner, E.	Jahrb. f. Kinderheilk., xcv, 43.	x				Deformed ears, eyes and genitals. At two and a half normal mentally.	Probability of lues in mother.
1923	26		x	5th	Hartmann-Fabre	Bull. Soc. de Obst. et Gyn., p. 167.	x				None.	Ca. of cervix Cesarean.
1923	27		x	3½	Bailey and Bagg	Am. J. Obst., v, 461.	x				Spina bifida, club feet, died on the fifteenth day.	Hodgkin's disease.
1923	28		x	6½	Bailey and Bagg	Am. J. Obst., v, 461.		x			None, died at the age of two and a half mos. from pneumonia.	Ca. of cervix, eclampsia, Cesarean.
1923	29		x	5½	Bailey and Bagg	Am. J. Obst., v, 461.	x				Normal at the age of three yrs.	Epithelioma of vulva.
1924	30	x		3d	Schmitt, W.	Strahlenther., xviii, 423.	x				None.	
1924	31	x		1½	Schwab	Presse med.	x				Microcephalus strabismus.	Cesarean.
1924	32	x		3d	Abels	Wien. klin. Woch.	x				Microcephalus mongolian idiot.	
1925	33	x		3d	Zappert	Wien. klin. Woch.	x				Microcephalic, microophthal. and bony deformities.	

by a castration dose of roentgen rays, without any evidences of a return of function three months after the exposure, proves once more the biologic truth, that the reaction in a tissue following irradiation is immeasurably influenced by the biologic state of the organ at the time of the exposure. The kinetic state in the ovary during gestation is far more labile than during any of its physiological states, hence the greater destruction of its generative system by the same dose of radiant energy, which in the ovary of the non-pregnant produced only a destruction of the tertiary follicles, leaving the primary follicles intact, which after the wearing off of the radioactivity, may once more resume their normal function. The interstitial cells have shown the greatest resistance to the effects of the rays, even during pregnancy.

IV. BIOLOGIC AND HISTOPATHOLOGIC OBSERVATIONS AND COMMENTS

1. Of the three types of follicles, the tertiary proved to be the most susceptible to irradiation, and the ovule the most sensitive part in the generative system. The interstitial gland (or corpus luteum) offered the greatest resistance. Reifferscheid, Eymer, Nürnberger, Penzoldt, Gauss, Pankow, Seitz and others corroborated these observations. The biologic reasons underlying these differences in radiosensitiveness are the variabilities in the kinetic states of the tissues. Since the tertiary follicle is the most active of the three types, at the time of the exposure, and since the ripening ovules are the centers of greatest kinetic unrest, they must fall as the first prey to the destructive effects of the rays. During the gravid state the kinetic energy in the ovary is at its highest peak, consequently its radiosensitiveness is most acute, and therefore a castration dose injures not only the tertiary, but also the secondary and the primary follicles. In Figure 15 these facts are well illustrated. The clinical significance of this fact will be discussed later on.

2. The structural and the functional phenomena observed in a roentgen castrated ovary simulate those taking place in the ovary during a menstrual cycle. The following are the exceptions to be noted: (*a*) The so-called stimulating effect of irradiation noted about the third week after irradiation is of a much stronger tempo, for many more follicles mature than normally; (*b*) the ovulating process is not completed for the ovules die before its termination, and hence (*c*) the absence of corpora lutea, noted with frequent regularity, in most of my specimens.

3. At or about the fifth week after irradiation the ovary showed once more an increase of interstitial cells, and an inhibition of follicular activity, while at the end of the fourth week the reverse of the expected condition obtained. How can we explain this paradox? Under the established rules governing radioactivity, its decline once begun should have continued in a downward path, but instead we observed an apparent ascent, as indicated by the structural changes described. The only way in which this enigma can be clarified is by the physiologic fact that there is a timely difference in follicular ripening, therefore some follicles have responded much later to the effects of the rays, and a delayed ovulating cycle with its concomitant structural ascent and decline was enacted, without the necessity of an additional irradiation. Viewed in this light, the apparent increase of radioactivity at the end of the fifth week may be understood.

4. The castration effect in the rabbit was over by the end of the seventh week after irradiation, as evidenced by the quite normal appearance of the ovary at that time. (Its positiveness is now being tested by further experiments to be published in the future.) This fact may serve in prognosticating the duration of the castration effect in the human. Further observations will determine the value of this thought.

5. The return of ovulation and menstruation after roentgen castration must be due to a ripening of primary follicles, which were not affected by the irradiation, but were only temporarily inhibited by the persistence of the interstitial gland (or corpus luteum).

6. The controversy about the histogenesis and function of the interstitial gland, began with Pflüger in 1863, and it is still agitating the minds of contemporary

investigators. Among the protagonists in this dispute are Bouin and Ancel, Sobotta, L. Fränkel, Stieve, Steinach, A. Lipschutz, and others. It would take me too far afield were I to indulge in a discussion of this academic problem at the present time. From my own observations on the ovaries of virgin rabbits, six to eight weeks old, I may state that at this age I failed to find well-formed corpora lutea, in the majority of instances. The only corpora lutea, i.e., well-circumscribed masses of lutein cells, enclosed in a fibrous envelope, but hardly differing histologically from the surrounding interstitial cells, were present in the ovary of the gravid rabbit. The intergenerative structure which, at all times, stood out with varying prominence, according to the physiologic state of the ovary, was the interstitial gland. From its structural variations concomitant with the functional states of the ovary, and from the close resemblance of its cells to those of the corpus luteum, I am of the opinion that, in the virgin rabbit at least, the interstitial gland fulfills the function of the corpus luteum. The increase of lipoids in the interstitial cells during gestation, lends further support to the supposition that this structure functions as a nutrioceptor in the structural scheme of the ovary.

From the histologic studies of my specimens, I am also led to believe that the ovarian stroma proper is the histogenetic source of the interstitial cells. For if the interstitial gland or its cells were to disappear as do the cells of the human corpus luteum after their function is terminated, then they too ought to have been replaced by scar tissue, similar to the one noted in the human ovary. This, however, does not obtain in the rabbit ovary, for with the involution of the interstitial gland there is a reappearance of normal looking ovarian stroma. It must hence be assumed that whenever increased nutritional demands are made upon the ovary as a whole by the maturing or ripening ovule, or ovum, as during the pregravid or gravid states, then the cells of the ovarian stroma undergo a marked paraplastic change and are converted into the epithelioid type, the interstitial cells; and when this demand is over they resume their former shape.

Very recently Zondek in his studies on the localization of the ovarian hormone has shown that the interstitial cells (or theca cells) do contain the ovarian hormone during the process of ovular ripening, and later on the granulosa cells, the future lutein cells, take over the function of hormone building. In this discovery my histobiologic hypothesis finds great support, and the interstitial cells may be considered both as nutrioceptors and hormone producers.

V. CLINICAL PROBLEMS IN OVARIAN IRRADIATION

Temporary Castration. This problem in radiotherapy still furnishes a fruitful soil for speculative argumentation, and clinical disagreement of a serious and acrimonious nature. The earliest opponents to ovarian irradiation even with castration doses, were Döderlein, Krönig, and Sellheim. More recently Werner, Martius, Driessen, and Unterberger have joined in condemning temporary castration. The last named author has lent prophetic fervor to his admonition by saying: "Woe will be unto us when the future generations will invoke their imprecations upon us for our polypragmaty in roentgentherapy." Less emphatic but equally sincere are the warnings of Bailey and Bagg. This clinical dread has its roots firmly implanted in the experimental and clinical data, which tend to ascribe the physical and mental defects in the offspring of previously irradiated parents, to the effect of the radiant energy.

On the other hand, we find a considerable number of eminent radiotherapists who have extended the field of ovarian irradiation to wide dimensions without the least hesitation or fear. As a striking example, I will cite the very latest report from the Seitz clinic, made by Guthmann and Bott. These gynecologists employ temporary ovarian castration with the most gratifying results, in irregular or excessive uterine bleeding, associated with chronic gonorrheal adnexitis; non-gonorrheal adnexitis and parametritis; and in tuberculous adnexitis. They also resort to temporary castration in young women suffering from menorrhagia or metrorrhagia due to fibroids, and who for some reason cannot

or will not undergo surgical treatment. Some types of preclimacteric functional metrorrhagia, and menstrual psychoses have also been treated by temporary castration. Then a group of patients suffering from constitutional diseases such as pulmonary tuberculosis, or osteomalacia, in whom the loss of even a normal amount of blood during the menstrual flow, is considered a drain upon their health, were temporarily castrated.

Between these two extremes, of utter condemnation, and a very wide clinical application of complete or partial ovarian castration, the clinician wavers, and is undecided as to which of these two schools is in the right. Whom shall he follow? Only through a careful and unbiased evaluation of the experimental, the clinical, and the biologic data forming the bases of these diametrically opposite viewpoints, may we reach a sound understanding of the problem, and evolve a safe plan of ovarian irradiation.

The Experimental Data Purporting the Dangers of Ovarian Irradiation. The experiments of Bordier, Baldwin, Gilman and Baetjer, the Hertwigs, Hastings, Beckton and Wedd, Movar, Perthes, and others are undoubtedly valuable scientific acquisitions. But we must bear in mind that the subjects of their experiments were the eggs of the silk worm, the fruit fly, and different forms of amphibia, and that we cannot transfer the results of these experiments directly to the mammalian species without discounting a great deal for the vast developmental differences separating the entomologic and the amphibian series from the warm-blooded animals. These vast structural differences also influence the radiosensitiveness of the cells, and we cannot take for granted that the cell of a butterfly has the same radiosensitiveness as that of a human tissue. Recognizing this fact, investigators began to employ warm-blooded animals in their experiments, so that their results may not be so distant biologically from that of man as are those obtained from the far simpler forms of life. Let us analyze these experiments.

Hippel and Pagenstecher experimented with pregnant dogs, and their results were either abortions, dead fetuses, or cataracts in the surviving offspring. The dose employed was 20 Holzknecht units, the equivalent of a 30 per cent skin erythema dose of Seitz and Wintz.

Regaud, Nogier, and Lacassagne also irradiated pregnant dogs, and obtained results similar to those of Hippel and Pagenstecher.

Hansen irradiated pregnant rats and the offspring were either sterile, or showed eye defects and deformed skulls. No statement of dosage is made.

Lacassagne and Coutard employed rabbits, the dose of roentgen rays used being stated as follows: focus skin distance 25 to 32 cm.; filter 6 mm. Al; 2.2 to 3.5 ma.; irradiation time 30 to 90 minutes; spark gap 25 cm. The entire abdominal region was irradiated. The results were: death of the young *in utero*, or soon after birth with anatomical defects, if the irradiation was carried out at nearly full term. As to the harm accruing to the mothers, the following facts were observed: temporary sterility for from three to four months; followed by normal conceptions and pregnancies; or a diminished fecundity, and an increase in the number of abortions or stillbirths. The full term progeny showed a higher mortality due to intestinal disturbances of a toxic nature.

Bagg and Little employed white mice. The factors in their experiment were: Target skin distance 12 inches (30 cm.); spark gap 2½ inches (25,000 volts); 10 ma.; no filter; time of exposure 12 seconds on five successive days; surface irradiated, the entire dorsal aspect. Both parents were irradiated, and out of the two successful matings abnormal eyed animals, showing also other developmental anomalies, were obtained in the third and subsequent generations. The authors comment on the fact that their dose was comparatively light, and state that, "the above results have apparently shown that X-ray irradiations of a group of mice has resulted in at least the progeny of two distinct matings, in the expression of a general tendency to the production of abnormal structures, which were definitely inherited. It is possible that such a tendency was present in the stock before irradiation was instituted, but if such was the case it seems

unlikely that we should have selected for treatment only the animals conveying such tendency to abnormality. The absence of the characteristic eye defects in the control group, and their presence in two of the irradiated lines, is suggestive, that irradiation was in some manner related to their production."

Movar employed sterilizing doses, and in only a small percentage of his cases were mutants found.

Unterberger irradiated both the ovules and the spermatozoa immediately before copulation, and found that the progeny was somewhat smaller in size than the mothers, but otherwise presented no deviations from the normal, either in color or in markings. He also noted a reduced fecundity in the offspring.

Martius and Fränkel irradiated the ovaries only, and the females were covered eight days later, so as to permit the rays to exert a definite effect, and the results were leanness, slight diminution in size, sterility, and coarse fur in some of the offspring.

The above cited experiments constitute the bulwark of the opponents to ovarian irradiation, and while we may not question the truth of the observations recorded, we do question their value as clinical guides, in the determination of the true status of ovarian irradiation. The chief reasons for this doubt are the following:

1. There is a vast difference between the experimental and the clinical objectives. Almost all of the above experiments were carried out with the end in view to determine how much damage can be done to the ovaries or the offspring with radioactive substances, while clinically we are interested in finding out how much harm the ovary can stand, and still regain its full normal function after a shorter or longer period of suspension. Temporary sterilization, and ovarian stimulation, are totally different clinical problems from that of permanent ovarian castration.

2. Dosage, the most important keystone, next to the biologic state of the tissues, in the arch of radiotherapy, has had its principles violated or neglected in most of the experiments mentioned. Search as we may, it is difficult to find clear cut statements, in most of the publications, concerning dosage. And if the dose is stated, its quantity was varied so perceptibly during the same experiment, that we can no longer accept the result as uniform and conclusive. For example, Lacassagne and Coutard, as well as others, speak of their experimental conclusions as homogeneous biologic facts, although they kept on changing the skin focus distance from 25 to 32 cm., and the irradiation time from 30 to 90 minutes, during the very same series of experiments, without giving the slightest heed to the fact that changes in skin-target distance and time of exposure call forth quite different reactions in the irradiated tissues.

3. Filtration, the principles of which were formulated after many years of careful research, has also been bungled in most of these experiments. How can we accept as uniform biologic conclusions, the experimental results emanating from procedures in which no distinction is made between the use of 6 mm. of aluminum, and no filters at all? Are the principles of filtration to be thrown overboard as useless impediments in the science of roentgenology? Is it not an accepted biologic truth that just as different tissues during different states of activity, react differently to the very same dose of roentgen or radium rays, so will different quantities and qualities of radiant energy call forth different reactions in the same tissue? We must hence concede that the ovary irradiated with a very thick filter, and one irradiated with no interposition of filters, must be differently affected by the very same dose of radiant energy.

4. The physiologic similarity between the ovary experimented upon, and the one to be compared with clinically, has also been overlooked or considered as unimportant, by the opponents to ovarian irradiation. Those who protest loudest against this procedure, have repeatedly confused the results of irradiation during pregnancy, with those carried out during the non-gravid state. Most of the experiments quoted by the negativists were upon gravid animals, a condition with which the problem of permanent or

temporary castration has very little in common, for the results of irradiation during these two states are fundamentally different. Every schooled gynecologist is decidedly opposed to ovarian irradiation during pregnancy, unless he intends to induce an abortion or arrest the progress of the gestation, and is therefore in full accord on this point with those who denounce ovarian irradiation; but he is absolutely at variance with their opinion on the question of irradiation of ovaries before conception. The histopathologic studies of Schinz, and my own, show that the radiosensitiveness of the ovary as a whole, is far greater during pregnancy, than during the pregravid state, so that a castration dose of radiant energy applied during the former state will be far more destructive in its effects than during the latter condition. To recapitulate briefly I will state, that a castration dose of roentgen rays applied during the non-gravid state affects the tertiary follicles chiefly and destroys them beyond the power of regeneration, while the primary follicles remain insensitive. On the other hand, the very same dose of radiant energy administered to the ovary of a gravid animal will destroy most of the primary follicles as well, and produce a more certain or more lasting castration. And as far as the much dreaded damage to the offspring is concerned, I shall discuss this phase later on.

It is therefore biologically wrong to experiment upon gravid animals, and infer that the damage sustained by the ovary at this period will also accrue to it when irradiated with the same dose before the ovule becomes impregnated.

5. The size of the irradiated field and its proportional relationship to the body surface as a whole, has also been left out of consideration in most of the experiments, as if it mattered little in the biologic result. According to Landois-Rosemann the body surface in square centimeters (O), is calculated from the body weight (K) in grams (G), according to the following formula: $O - K \sqrt[3]{G^2}$, in which K represents the factor that remains constant for any animal species, Logarithm $O - K^2/_3$ log. The weight of an average person being equal to 60,000 gm., the skin surface according to this formula ought to be 17,220 sq. cm.; in a rabbit, average weight at eight weeks being 800 gm., the body surface ought to be equal to 940 sq. cm.; and in a white mouse of an average weight of 95 gm., the body surface must equal 22.3 sq. cm. Computing the relative proportions which the field of entry ought to bear to the body surface, in ovarian irradiation in animals, on the basis of the Seitz and Wintz castration method (which was used by Schinz and myself), which consists of four fields each 48 sq. cm., or a total of 192 sq. cm., we obtain the following equation: 17,222: 192: 946: X. The castration surface for the rabbit in sq. cm. would be 10.5; and for a white mouse 2.5 sq. cm.

In none of the experiments cited has this rule been observed. Lacassagne and Coutard irradiated instead of 2.5 sq. cm., the entire ventral surface of the mouse, or an area about 11.5 cm. in diameter, nearly five times as much as would be considered biologically proper. Bagg and Little irradiated the entire dorsal surface of the mice, again five times as much as was necessary if this experiment should serve for comparison with the human castration dose. Notwithstanding this fact Bagg and Little state that they have used small doses of radiant energy. Have these authors forgotten the fact that by increasing the field of entry, without changing any of the other factors in the roentgenologic equation, there ensues a proportional increase in the amount of radiant energy administered? Bagg and Little have actually given to their animals four times the amount of roentgen rays they presumed they did.

Another invalidating element in these experiments from a biologic and clinical standpoint is the more extensive local and general damage that must accrue from these far larger exposures than occurs in the clinical procedure of ovarian irradiation; and the smaller the animal experimented with, the greater the risk of including other vital organs and endocrines besides the ovaries in the irradiation field. Fraenkel and Geller, and Poos have called attention to this fact, but the experimenting biologists and radiologists have given little heed to this warning. Schinz and

myself are not free from this transgression, but the differences in our experiments are not so wide and striking as those of Lacassagne and Coutard, and of Bagg and Little.

Having analyzed the most important experimental data purporting the inadvisability and danger of ovarian irradiation, I may sum up by saying that their conclusions are not tenable clinically, for they were not carried out according to the recognized and accepted biologic and physical laws governing such studies.

Experiments Purporting the Safety of Ovarian Irradiation. The outstanding experiments contradicting the findings of Bagg and Little are those of Nürnberger. In spite of his numerous experimental attempts to produce developmental anomalies in the offspring of irradiated white mice, in which both parents were irradiated, he failed completely. These animals have either given birth to normal offspring, or they remained sterile. Nürnberger's observations are far more extensive than those of Bagg and Little, for they include records of 104 offspring of the second generation, and 14 of the third, in which not the slightest developmental abnormalities were found. In his very latest publication Bagg states that in collaborating with MacDowell to repeat his original experiments in which such marked developmental defects were obtained he has thus far failed, although several thousand animals have been observed. Schinz's attempt to produce malformations in the offspring of irradiated pregnant animals also resulted in failure, the animals have either aborted, or the embryos were absorbed, or they were found dead *in utero.* In my experiment with irradiation of a pregnant rabbit I found the fetuses dead in the uterine horns.

From these experiments we gather that ovarian irradiation during pregnancy will, as a rule, cause the death of the embryos, which will be aborted or retained *in utero* and become absorbed; and if the dose of radiant energy used is not of sufficient intensity to destroy the products of conception, then the pregnancy may go to term, and normal offspring will be born. I shall revert to the discussion of this point later on.

Clinical Data for and against Ovarian Irradiation. It would be time wasted were I to cite in detail the records of the many hundreds of normal children born to mothers who have undergone ovarian castration with roentgen or radium rays at some time before conception. These are well known and undeniable facts, which testify to the truth that those follicles which remain insensitive to the effects of the rays, are capable of impregnation, and the production of normal offspring. Of far greater value in the search for clinical guidance in the problem of ovarian irradiation is the study of the abnormal children, whose physical and mental defects are ascribed to the harm produced by the irradiation of the mothers, or of both parents, before or after conception. For this purpose I have tabulated all the cases I could gather into two separate groups as indicated in Tables I and II.

An analysis of the clinical data brings forth the following facts:

1. The vast majority of conceptions following ovarian irradiation, even after a castration dose, terminate in normal offspring, for out of the many hundreds of children born to mothers irradiated before conception, only 19 cases presenting some form of physical or mental abnormality, could be collected. A close inquiry into the nature and character of these developmental or constitutional blemishes reveals that in only 3 instances were definite defects present, while the rest showed only constitutional disturbances, which are also met with in children of non-irradiated women. And when we take into consideration the additional facts that the mother's state of health, her age, and parity, also influence to a very marked degree the ante- and post-natal development of the offspring, then the arguments against ovarian irradiation become still weaker. Pediatricians and neurologists have stated repeatedly that elderly fecund multiparae are apt to give birth to mongolian idiots, and in the instances cited by the radiologists this observation is often substantiated. In the case cited by Bailey, the mother suffered from an advanced Hodgkin's disease and was irradiated repeatedly with massive doses of radium. In some of the other cases

the mothers were afflicted with hyperthyroidism. Viewing these facts in their true light, we must admit that the grave constitutional disorders from which the mothers of these defective children suffered were far more responsible for the deficiencies noted in the offspring than the preceding ovarian irradiations; and that the occurrence of these malformations were coincidences, which would most likely have taken place without the irradiation.

2. Notwithstanding the fact that in 72.3 per cent of the cases in which the irradiation was carried out during pregnancy, the offspring failed to show any deviations from the normal, we must accept as undeniable proof that the greatest harm accruing to the progeny from roentgen or radium treatment of the ovaries occurs if the treatment is administered after conception. And that the earlier the period of gestation, the greater the harm. The biologic reasons will be given later on.

Biologic Data of Ovarian Irradiation. It is now conceded by the leading investigators, and also verified by the present study, that a castration dose of roentgen rays destroys the tertiary follicles, most of the secondary follicles, and leaves the primary follicles unaffected, or so slightly altered, that they continue to function normally as soon as the general effect of the irradiation has abated. Upon these biologic facts do the principles of permanent or temporary ovarian castration rest.

The human ovary contains at birth from three to four hundred thousand primordial follicles, thousands of them mature, but only about three hundred and sixty complete the ovulating cycle during the procreative life of a woman. It therefore stands to reason that the younger the irradiated individual, the greater is her reserve stock of unaffected primary follicles, and hence the greater her chances of regaining her ovarian function, even after an intended permanent castration treatment, but most assuredly after a smaller dose has been administered.

The statement of Gauss and Friedrich that the ovaries of older women are more radiosensitive than those of younger persons, because we can produce permanent castration much more readily between thirty and forty years of age than between twenty and thirty, is clinically substantiated, but biologically misinterpreted. The real biologic reason why older women can be castrated permanently, with greater assurance than younger individuals, with the very same dose of radiant energy, is because the older women have a smaller reserve of potential follicles. This difference is therefore not qualitative but quantitative in nature.

We may hence postulate that the castration dose bears an inverse ratio to age, and the older the patient, the smaller the dose. The same rule applies to the induction of temporary castration. Persons below thirty would require 25 to 30 per cent, and older persons 20 to 25 per cent of the skin erythema dose. Guthmann and Bott after a very wide clinical experience reached the following conclusions: (*a*) the larger the dose, the longer the ensuing period of amenorrhea, and (*b*) the younger the patient, the shorter the period of amenorrhea. These conclusions are in full accord with the present-day concepts of the biology and physics of ovarian irradiation.

Having presented an exhaustive array of biologic, experimental and clinical data pertaining to the problem of ovarian radiotherapy in general, I shall now proceed to a specific consideration of the most important clinical problems in the realm of ovarian radiotherapy.

A. WHAT EFFECT HAS A CASTRATION DOSE OF ROENTGEN RAYS UPON FUTURE CONCEPTIONS

The histologic studies of roentgen castrated ovaries showed that this amount of radiant energy leaves the primary follicles intact, and that after a shorter or longer interval following the castration, these follicles resume their function, ripen and are capable of impregnation. This experimental fact finds clinical verification in the reports made by Clark and Keene, Flaskamp, Ganzoni and Widmer, Martius, Matthews, Nürnberger, Schmitt, Stacy, Thaler, Werner, and many others, of hundreds of children born to previously roentgen or radium castrated mothers. In view of this evidence we may state that the

so-called castration dose varies in the duration of its effect with the age of the patient, and that the younger the patient, the shorter its duration; and that with the return of ovarian function the properties of conception are also reëstablished.

B. IS IT SAFE TO PERMIT A PREGNANCY FOLLOWING OVARIAN IRRADIATION TO GO TO TERM?

Borell states: "Until now not a single authentic case of maldevelopment in the human, following irradiation of the mother, has been recorded;" and Manfred Fränkel claims that "follicles capable of ripening after a preceding irradiation cannot possess defects which will manifest themselves in succeeding generations." My critical analysis of the cases of maldevelopment ascribed to ovarian irradiation has shown quite conclusively that these statements or claims are unfounded. It is hence not at all irrational to postulate that pregnancies following irradiation will terminate in as many normal offspring as obtains in pregnancies of non-irradiated mothers.

Viewing, however, this problem from a purely biologic standpoint, and acceding to the claim made by some investigators, that while the irradiated follicles capable of ovulation and impregnation may not show microscopically recognizable alterations, they may nevertheless harbor defects which will manifest themselves in the offspring of the second and the third generation, I still maintain that these fears and untoward results have no clinical significance or application. We must bear in mind that the facts upon which the above fears are based were obtained experimentally, in which both parents were irradiated, and the offspring of these parents were mated; conditions which never obtain in the medical employment of radiation therapy. Nürnberger's opinion on this point is so clear and convincing that it bears full citation. Referring to the experiments of Bagg and Little, he says: "In the human, in-breeding of the first generation is practically non-existent. As a rule we are dealing with the following conditions, that the child of an irradiated mother marries the child of an non-irradiated mother. The offspring of these parents are all well, and only one half of them harbor the hypothetical diseased anlagen. When these recessive heterozygots marry normal individuals, their offspring will again be normal. Only then when accidental mating between two individuals of irradiated mothers takes place, and both of them are affected with the same recessive hereditary defects, is it probable that 25 per cent of this issue may manifest abnormalities."

It is hardly necessary to add anything to the scientific firmness of this thesis, in support of ovarian irradiation before conception, as a safe and sound therapeutic procedure. But in order to allay the slightest fear that may still linger in the mind of the most timid clinician, and remove the remotest possibility of developmental anomalies in the offspring of irradiated mothers, it is suggested by Nürnberger, and by Wintz and Penzoldt, that no conceptions shall be permitted in irradiated mothers until after roentgen amenorrhea has been fully established. With this additional precaution, temporary castration and its subsequent pregnancies are divested of all the theoretical objections; and the question as to whether a pregnancy following ovarian irradiation may be permitted to go to term, may be answered in the affirmative.

C. WHAT EFFECT HAS A CASTRATION DOSE OF ROENTGEN RAYS UPON PREGNANCY?

In marked contrast to the harmlessness to the offspring from ovarian irradiation before conception stands out the devastating effects resulting from irradiations after the ovule becomes impregnated. The biologic reasons for these differences are the following. Since radioactive substances exert their strongest effect upon those cells whose kinetic energy is in the state of greatest unrest, it is evident that the embryo from its morular and blastular stages onward, represents the center of highest kinetic lability, and hence is most sensitive to roentgen or radium rays. This is borne out experimentally and clinically by the fact that the greatest harm accrues to the offspring from irradiation, if the latter is administered during pregnancy. And the earlier in the period

of gestation this treatment is applied the more destructive are the results.

Fortunately for us, the vast majority of pregnancies irradiated during the first trimester terminate in abortions, or in the absorption of the embryos, so that the fear of the birth of monstrosities or otherwise defective children is greatly minimized. But should the expected abortion not ensue; or should an irradiation be carried out on an unsuspected gravida, and the uterus fails to expel the ovum, then it becomes imperative to terminate the gestation surgically. Although I have shown that in ~2.3 per cent of irradiated gravidities the offspring failed to manifest any developmental defects, it is nevertheless a clinical error to permit such pregnancies to go to term unless the irradiation has been carried out during the last trimester.

Another valuable clinical lesson taught us by the variability in the radiosensitiveness of tissues and cells according to the degree of lability of their kinetic energy, is the fact that we can induce an abortion with a smaller dose of roentgen rays than is required to establish an ovarian castration, for the biologic state of the embryo is in a state of greater lability than is that of the tertiary follicle.

This leads to another implication, that the amenorrhea following ovarian irradiation during pregnancy, will be more lasting, or more positively permanent, than during the non-gravid state, for the ovary as a whole is far more radiosensitive during pregnancy. This was proven in my experiments, in which the ovary of the gravid rabbit showed more extensive destruction of all three types of follicles, with the same dose of roentgen rays as was applied to the ovary of the non-pregnant animal.

Reasoning by analogy we may also state that since the embryo is more radiosensitive than the tertiary follicle, it is not at all necessary to irradiate the ovaries in order to induce an abortion, but limit the irradiation to the uterus, and spare the generative glands. Some gynecologists have made this attempt, with gratifying results, and this procedure should commend itself when we do not wish to induce a castration at the time of the interruption of the pregnancy.

In rendering an answer to our query as to the effect of a castration dose of roentgen rays upon pregnancy, we may state that ovarian irradiation during pregnancy, particularly in the first half of gestation, is detrimental to the offspring, and should not be undertaken, unless we intend to interrupt the gestation.

D. IS THE SO-CALLED ROENTGEN STIMULATION OF THE OVARY A DIRECT EFFECT OR AN INDIRECT RESULT OF FOREIGN PROTEIN SENSITIZATION?

With the advances made in the biophysics of roentgenology, numerous attempts were made to arouse dormant or insufficient ovarian function, by means of small doses of radiant energy. Some of the reported results are miraculous, others total failures. What is the rationale of this therapeutic attempt?

A stimulant, in the physiologic sense of the term, is a remedy or means which while increasing the function or growth of a tissue or organ does not at the same time produce damaging effects. Radiant energy does not fulfill these demands, for the mildest dose of rays produces either biochemical alterations or structural changes of an abnormal character. Botanists and zoologists have shown repeatedly that they can stimulate plant and animal growth and development by appropriate irradiations, but the resultant flora and fauna were of an inferior quality. Something was sacrificed upon the altar of stimulation, something fundamental was injured. Experiments with mild irradiations of frog and toad eggs immediately before conception resulted in inferior offspring. The histopathologic studies of the present work show that the primary effect of a castration dose is stimulative in character, as it hastened the ripening of the tertiary and of some of the secondary follicles, while the primary were histologically not affected. Holzknecht is averse to the theory of "ovarian stimulation," and states that, "All so-called stimulations following irradiation are the result of cellular damage, and the removal of the physiologic inhibitory and regulatory forces, thereby calling

forth abnormal hyperfunction." Martius, Scholten and Voltz, Mühlmann, and others consider the stimulating effect of ovarian irradiation as a foreign protein sensitization, resulting from the breaking down of irradiated cells and the liberation of ferments and the end products of albumin decomposition.

In view of these facts and theories, is it not safer to rely rather upon the oral or subcutaneous administration of specific glandular products? The very recent product of follicular hormone, elaborated by Frank Allen and Doisy, Zondek and Aschheim is very promising. The advantages of opotherapy over radiotherapy in the treatment of oligomenorrhea and amenorrhea is, that the successes are not purchased at the expense of the destruction of ovarian parenchyma, and that in case of failure, the treatment may be repeated *ad libitum*, without the least risk of completely exhausting the meager reserve of potential follicles of these inferior types of generative glands, which would inevitably result from repeated stimulation by roentgen or radium rays.

SUMMARY

1. In order to formulate clinical deductions in radiotherapy, from animal experimentations, it is of utmost importance that the test object should stand in as close a biologic sequence to the human as possible, and that the dose employed should correspond exactly to that used clinically and it should be administered under identical physiologic conditions.

2. The castration dose of roentgen rays for the rabbit is equal to 1-0 per cent of the human skin erythema dose (Seitz and Wintz), and it is biologically manifested by a complete epilation of the irradiated area at or about the seventh week after the exposure.

3. The tertiary follicles are the most sensitive to the castration dose, the ovule is affected first; the interstitial cells or gland (or corpus luteum) is the most resistant.

4. The so-called castration dose of roentgen rays does not affect the primary follicles sufficiently to interfere with their normal function after the roentgen amenorrhea is over. The amenorrhea setting in after a roentgen castration is due to the persistence of the interstitial gland (or corpus luteum), which becomes dominant after the destruction of the tertiary follicles, and keeps the primary follicles in check.

5. The primary effect of a castration dose is stimulative in character, as evidenced by a quicker tempo of the ripening process in the follicles, whose ovules undergo degeneration before the cycle is completed.

6. The so-called stimulating effect of small doses of roentgen rays is in reality an indirect result of foreign protein sensitization, resulting from the breaking down of the more radiosensitive ovarian elements.

7. Temporary castration can be accomplished, particularly in younger persons, and the castration dose is in inverse ratio to age.

8. Ovarian irradiation, except when carried out during the early months of gestation, is free from harm to the offspring and should be employed without any fear, in all cases where a permanent or temporary suspension of the ovarian function is indicated.

9. If an intended roentgen abortion does not follow within one or two weeks after the irradiation, the uterus should be emptied surgically, for the neglect to do so may result in the birth of a physically or mentally inferior child.

10. The clinical fear entertained by most gynecologists and obstetricians that the pregnancies following ovarian irradiation may result in offspring showing somatic or psychic defects, has so far not been substantiated by careful and prolonged clinical observations.

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BONE CAVITIES*

A ROENTGENOLOGIC STUDY

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INTRODUCTION

BONE cavities may be considered in two main divisions depending upon the etiology: (1) Hemorrhagic, and (2) infectious. The infectious group as represented chiefly by osteomyelitis and tuberculosis is by far the more frequent and important, but since we are concerned here principally with the hemorrhagic group (bone cysts) we will consider the infectious type only in a general way and only insofar as it will bring about a clarification of the hemorrhagic type.

The diagnosis of bone cysts has been greatly confused by the fact that these are so often intimately associated with processes the names of which have been used interchangeably such as osteitis fibrosa of von Recklinghausen, osteitis deformans of Paget, osteitis cystica, osteodystrophia fibrosa, and that they are frequently associated with osteoporosis and osteomalacia. Because of this confusion we will attempt in this communication to put on a definite basis the roentgenological diagnosis of bone cysts as an entity. We will make, therefore, a general review of the old and a more detailed analysis of the more modern ideas of the pathogenesis of bone cysts, emphasizing particularly those of Pommer and Looser since the purpose of this work is to clarify the term bone cysts from the roentgenological standpoint in agreement with their observations. We cannot enter a lengthy criticism of the standpoint of the various authors or the status of Paget's disease, osteomalacia and rickets in relation to osteitis fibrosa. We will confine ourselves to a discussion of these insofar as it enables us to make clear our conception of bone cysts. Many authors do not specifically mention the term cyst but use osteitis fibrosa as a comprehensive one for the syndrome of marrow reconstruction, brown tumors and cysts.

PATHOLOGY AND PATHOGENESIS

Dupuytren[1] first called attention to bone cysts and gave jaw cysts as an example. Virchow[1] advanced the teaching that in bone cysts one deals with the softening of tumors. He described a cyst in the upper part of the humerus diaphysis which he considered a softened chrondroma because he found isolated tissue islands in the bone marrow near the cystic space which had the same fibrous cartilaginous character as the wall of the cyst. Schlange,[1] Kehr,[1] König,[1] and Miessner[1] have described smooth-walled cysts in central fibroma and giant cell sarcoma which were due to softening of the tumor.

Von Recklinghausen[2] described cases of what later came to be considered a disease entity bearing his name. He found the following: a generalized osteomalacia in more or less widespread bone cuts. The bone marrow was changed to a fibrous tissue of varying cell richness containing giant cells. There was evidence of osteoclastic resorption of old bone with displacement by new, fine, porous, partly calcium-free bone; there was, then, a complete active reconstruction (umbau) of old compact bone to a new, fine, porous one. Cysts were often found in the fibrous marrow sites and von Recklinghausen considered that these were due to softening of the fibrous tissue. The richly cellular (giant cell) brown tumors containing brown iron pigment were held to be true giant cell sarcomas or myelogenous tumors. He considered this entity of cysts, marrow construction, and tumors to be related in some way to osteitis deformans Paget, which also had fibrous marrow changes, reconstruction of old bone to fine porous new bone but which he considered different in that there was an absence of cysts and brown tumors.

Schmidt[3] accepts cysts as the result and concomitant of osteitis fibrosa Reckling-

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hausen and this idea has found general approval. Christeller[4] (in the Institute of Prof. Pick) considers cysts and brown tumors as degenerative softenings of a porotic hyperostotic form of osteitis fibrosa. Beneke[5] first expressed the idea that bone cysts are of traumatic origin and develop from marrow bleeding. He presumes a genetic relationship parallel to apoplectic brain cysts. In experimental marrow bleeding Lexer[6] and Lotsch[7] obtained no positive results in the sense of cyst development.

On the basis of his own studies and those of others, von Mikulicz[8] expresses opposition to the idea of tumor softening or degeneration as the cause of cysts. He considers cystic disease of bone as a disturbance in the development of the growing skeleton characterized by its presence in youth, its affection predominantly of the long bones of the extremities, the intensity of which varies directly with the rapidity of growth, its benignity (absence of metastasis or recurrence after operation), and its development usually months or longer after trauma. The cysts are usually isolated, rarely multiple. Adjacent to the complete cyst construction or in other sites there are undeveloped stages in which the bone tissue is displaced by connective tissue (osteoid) and richly cellular areas of giant cells. von Mikulicz suggests that this cystic construction in the juvenile skeleton be considered *sui generis* and be called osteodystrophia cystica.

According to Platou[9] cysts are usually found in osteitis fibrosa but are also found in osteomyelitis, osteoporosis, osteomalacia, parasitic diseases and in the softening of tumors (chondroma and sarcoma). Although he admits that trauma appears in many cases as the etiological factor he cannot explain how it causes the disease or influences its genesis. He states that bones which develop cysts after trauma must have been diseased previously. Caan[10] and Kott[11] consider osteitis fibrosa as an entity. Roederer[12] differentiates solitary cysts of long bones (benign growths) from osteitis fibrosa (cystica) von Recklinghausen. Machard[13] considers cysts and brown tumors as concomitants of von Recklinghausen's disease which has different forms varying in quality and quantity with the age of the patient and the presence of cysts. Borchard[14] and Rumpel[15] differentiate the solitary bone cysts of youth from osteitis fibrosa Recklinghausen. They consider it as a local circumscribed disease whose adjacent bone parts are healthy and which is probably the result of circumscribed traumatic marrow bleeding, whereas osteitis fibrosa is a systemic disease in which large parts of the bone are involved. Nissen[16] reports cases of two patients who had positive Wassermann reactions and solitary cysts which developed after trauma. There were no evidences of bone gumma or luetic periostitis. However, he assumes that the circumscribed bone change is not the result of the accident but that a luetically caused inferiority of the entire vascular system and vascularization preclude resorption and connective tissue growth in the intraosseal hemorrhage and in this way the cysts were built. He feels that these cases speak against localized cystic osteitis fibrosa as a pathological entity.

Heinlein[17] mentions the three current ideas of the origin of bone cysts: tumor softening, osteitis fibrosa, and trauma. He feels that most observers believe trauma to be the chief cause in the localized osteitis fibrosa, and softening of the fibrous tissue in the generalized form. He questions the relationship of solitary cysts to localized osteitis fibrosa. In two cases which he reports, he found none of the three mentioned causes. Painter[18] does not accept trauma as an etiological factor in osteitis fibrosa nor does he acknowledge a relationship to osteitis deformans Paget, giant cell sarcoma, syphilis or osteomalacia. On the basis of his own observations and others of osteitis fibrosa cystica of the skull, Tonndorf[19] assumes that it is a benign localized disease whose cause very frequently appears as trauma. Konjetzny[20] defines cyst development (localized osteitis fibrosa) as the specific reaction product of an injured bone marrow. The development of cysts or brown tumors after definite antecedent trauma is reported by Bloodgood,[21] Fabris,[22] Dreifuss,[23] Greig,[24] Krogius,[25] Rogers,[26] Fauconnet,[27] Dario,[28] Lake and Schuster,[29] Martin,[30] and others.

Kaufmann[31] classifies cysts of bone as pseudocysts and true cysts. The pseudocysts are inflammatory or degenerative softenings of giant cell sarcomas, metastatic carcinomas, or chondromas. True cysts occur after trauma in osteomalacia, and osteitis fibrosa. He believes that osteitis fibrosa and osteitis deformans are different types of the same process in which the fibrous osteitic tissue comes to cyst formation by softening. He also mentions parasitic (echinococcus and cysticercus) cysts.

Bloodgood[32] who has studied a large number of bone cysts considers them in two groups: (1) true bone cysts which have a definite relation to osteitis fibrosa and may be unilocular or multilocular with varying proportions of cystic cavity and fibrous osteitic tissue, and (2) cysts in the medullary cavity due to conditions other than osteitis fibrosa (softening of giant cell sarcomas, enchondromas, myxomas; osteitis deformans; callus; subperiosteal hemorrhage with ossifying periostitic shell, and osteomalacia). He states that trauma is very frequently mentioned as a cause of true bone cysts (osteitis fibrosa), yet he feels[33] that "all the evidence is against trauma as a cause. The osteitis fibrosa which is the pathological process is undoubtedly an inflammatory process whose cause is not yet found," and suggests the name of chronic osteomyelitis fibrosa (solida or cystica depending upon the presence of cysts). In discussing giant cell tumors he points out the definite relationship of their origin and development to trauma and cites a case[33] in which a giant cell tumor developed in a previously normal bone which was operated on nine weeks after the causative trauma. However, what he calls giant cell tumor and differentiates from the cysts in pathogenesis and origin is considered by many observers to be the brown tumor (found in osteitis fibrosa) whose pathogenesis is also that of the cysts.

The endocrine system has frequently been mentioned either as an etiological factor or as showing concomitant pathology with cystic disease of the bone. Hamann,[34] Roth and Volkmann,[35] and Roederer[12] ascribe cystic disease of bones (osteitis fibrosa) to endocrine disturbance. Sternberg[36] Hartwich,[37] Nägelsbach,[38] Hoffheinz[39] and others report cases of osteitis fibrosa with parathyroid tumor. In Sternberg's case there was improvement after removal of the tumor suggesting its causal relationship. In a review of the literature Hoffheinz found 44 cases of parathyroid hyperplasia. Lubarsch[40] considers the relationship of parathyroid hyperplasia and osteitis fibrosa cystica as still not clear. In some cases of osteitis fibrosa, Schmorl[41] has found no parathyroid disease and, on the other hand, he has found it at autopsy in many instances where there was no disease of the bony skeleton.

THE POMMER AND LOOSER CONCEPTIONS OF BONE CYST PATHOGENESIS

There are certain basic laws as enunciedat by Pommer[42] which one must master in order to obtain a proper point of view of bone physiology and pathology: (1) Apposition and resorption continue during the entire life of bone. (2) Bone atrophy (generalized atrophy and not that caused by pressure, inflammation, etc.) is an imbalance between deposition and resorption, there being an arrest or disturbance of deposition while normal resorption continues. (3) The effect of chronic irritation is manifested in bones which have become insufficient through systemic disease by a fibrous change of the marrow and when the irritation is marked by a reconstruction (increased destruction of old bone and simultaneous new construction of fibrillar bone in the fibrous marrow). Such reconstruction zones are frequently seen in varying form and extent in all systemic diseases of bone. Lamellar and fibrillar (geflechtartig) bone play different rôles: the former where definite mechanical conditions are secure; fibrillar, where there are irritating influences.

Pommer[43] in a thorough study of bone cysts in a case of von Haberer comes to the following conclusions: (1) Cysts reveal indications of their hematogenous or blood sac nature. (2) Bleeding within rigid bony walls prevents drainage of blood and causes embarrassed circulation, venous stasis, serous exudation and edema. This leads to increased pressure in the site and a pres-

sure atrophy of the contiguous bone caused by the lacunar resorption so that there is broadening and extension of the space with cyst formation. The structure of the cyst wall confirms this: the fresh and old bone remnants in organization, the lacunar resorption of adjacent bone, the boundary of new bone of characteristic construction which shows the influence of pressure tension by its cellular form and direction. The combination of stasis and inflammatory reaction (phlegmasia) speak for a secondary change and not a primary one and allows no assumption of a primary osteitis fibrosa. (3) Single blood sacs allow the assumption that under certain conditions cysts may not enlarge because of some limiting or appositional influence which overcomes the tendency to enlarge. This explains the spontaneous healing of cysts before or after operation or spontaneous fracture. By incision a pressure tension relief may be effected and a diminution of the hemorrhage or transudate content. (4) The substitution of fat marrow by fibrous marrow is a result of a local limited influence and not a general extended one. It is a result of local stasis and an irritated condition due to marrow hemorrhage. The contention in favor of osteitis fibrosa Recklinghausen is not justified by the presence of fibrous marrow. (5) A hypothetical cystic softening could nowhere be found. (6) The chronic eccentric pressure atrophy which is caused by the tendency for steady enlargement and extension of the cyst, and the fibrous reconstruction of the bone marrow results in a loss of substance in which the consistency or firmness of the cystically changed bone suffers a steady loss.

Looser,[11] accepting the basic laws and findings of Pommer, has exhaustively studied bone cysts and built up a clinical, anatomic conception of their pathogenesis. He defines a systemic disease of the bones as an illness in which the bony system as a whole is affected, that is, all the bones in their entirety show the same affection which is characteristic of that illness. On the basis of such a definition there are but few systemic diseases of bones: (1) Osteogenesis imperfecta; (2) rickets and rickets tarda; (3) osteomalacia, and (4) osteoporosis (of varying etiological forms). The cause of such a systemic disease is extraskeletal and affects the skeleton by way of the blood or metabolism or through the intermediation of the nervous system. Since there is always a disturbance of normal physiological function (or events) in the bones in general in these systemic diseases, the grade of disturbance will depend not only on the age but on the general or local intensity of physiological events so that in the same individual the pathological changes in different parts of the skeleton may vary in grade.

It is important to understand that bone is the most reactive and regenerative tissue in the body undergoing constant reconstruction (umbau) and that every irritation, trauma, etc., produces a reaction. In bone the mass is a unit built purely on a static basis; the function is based not on individual cells or groups of cells but on the entire bone which is a physiological unit.

Looser[11] defines cysts of bone as cavities or hollow spaces within bone, smooth, which may be solitary or multiple, more or less round or oval, with a more or less definite covering membrane. They usually contain fluid. The size varies. They may be large, bean size to over hazelnut size. They may be so small that they are only microscopic. In the region of the larger cysts there may be many surrounding microscopic cysts. Consideration of the site shows that cysts are present in those regions which show signs or evidence of mechanical irritation. Even when they lie in normal marrow their position shows clearly that mechanical factors are at play. It is also noteworthy that in the radius they occur at the classical site where fractures occur. Solitary cysts of the long tube bones occur with predilection in the upper metaphyses of the humerus, femur and tibia and occur practically always in youth, while in adults they are rarely observed. The contents show either fresh blood with well-maintained blood elements, or poorly colored fluid with swollen destroyed blood cells, or yellow gelatinous homogeneous masses with no formed elements which stain red with eosin.

The cysts are usually one-cavitied but may have septa, complete or incomplete, so that actually they may also be multi-

cavitied. These septa which Looser found in the cysts and which may divide them into varying number of spaces are the results of organization of the bloody fluid contents caused by invaginating growths of giant cell containing tissue.

When cysts appear in otherwise normal bone they are solitary; in pathologic bone they are usually multiple. The pathological conditions in which cysts are found are: (1) osteomalacia; (2) rickets; (3) osteitis deformans Paget; (4) osteoporosis (of various causes); (5) callus, and (6) infantile scurvy. The definition of Looser includes the true cysts and cyst-like structures; false cysts, which differ pathologically and clinically, are less common and occur in tumor softening, parasitic disease, and in encapsulated abscesses in old chronic osteomyelitis.

The cysts may be resorbed or organized or persist. They can become stationary in certain stages; apparently when a pressure equalization occurs from outside. Spontaneous healing may occur by connective tissue organization of the cyst and bone construction in this young connective tissue. Such spontaneous healing has been followed clinically and roentgenologically. When they persist and pressure equalization does not occur, the cavities filled with blood enlarge through serous exudation or further hemorrhage and cause an adjacent atrophy and so continue to enlarge. The bone may thus become thin or even inflated. In such cases spontaneous fracture and bending in of the cyst wall may occur and thus be the first evidence of the presence of the cyst. This fracture with destruction of the cyst walls sometimes produces a quick healing.

The irritating effect of the bloody fluid on the surroundings causes the production on its surface of a cellular sarcoma-like connective tissue membrane containing in many places giant cells. These walls of the cysts may be few or multilayered and contain very closely crowded round connective tissue cells which in places contain varying amounts of giant cells. Outwardly it passes into poorly cellular connective tissue containing much pigment and rich in capillaries. The construction of the cyst wall varies with its location: when it lies in the fat marrow of the spongiosa, the wall is relatively thin and poorly cellular; in the corticallis the wall is multilayered and richly cellular.

Brown tumors are intimately associated with cysts. Both are of traumatic etiology and originate from hematoma. Cysts in general originate from hemorrhage in the marrow and brown tumors from that in the corticallis. The brown tumors show variation in size. They, too, are local constructions due to local causes. The small ones lie without exception in the corticallis and as they become larger protrude more into the marrow. Even the very large ones permit recognition of their cortical origin. Like cysts they show no evidence of periosteal or cartilaginous destruction or of infiltrative growth into soft parts. They are exquisitely benign structures whose spontaneous healing has been followed roentgenologically for one-half to one year from fresh tumor formation to healing. The nature of the brown tumors, their origin and their position in the corticallis allow here too the inference that mechanical factors are at work. The cysts and brown tumors very frequently occur together and Looser[14] presents evidence of the transition of cysts into brown tumors. The tissue of the brown tumors which corresponds histologically to the walls of the cysts points to its origin from a particular type of organization of bloody fluid.

The marrow which is built of fibrous tissue, and the reconstruction of bone in the neighborhood of the cyst by means of destruction of the lamellar bone and production of new, fine, porous, fibrillar bone, are expressions of a chronic, mechanical irritation. Neither cysts nor brown tumors nor this reconstruction of bone are an expression of an osteitis fibrosa as a disease entity but simply mechanically released symptom complexes which as such may occur in normal bone (solitary cysts) and in pathological bone (multiple cysts). If we refer, then, hereafter, to osteitis fibrosa von Recklinghausen it will be in the sense of a symptom complex and not a disease entity.

This symptom complex, osteitis fibrosa (cysts, brown tumors, fibrous marrow and

bone reconstruction) will occur in bones weakened by mechanical resistance and it is easy to understand why in a normal skeleton, in fact only in youth, cysts are solitary. In a young skeleton where the bone tissue is still elastic a trauma or bending causes a tearing of vessels and hemorrhage in the marrow without necessarily causing a fracture. Such trauma is naturally an accident and therefore not frequent. In adults, on the other hand, a marrow bleeding through trauma or bending without actual fracture is hardly possible in a normal skeleton, the bone being so hard and non-elastic as to ordinarily resist trauma. When the force, however, is too great to be resisted the non-elastic bone fractures.

von Haberer[15] also assumes the hematomatous origin of bone cysts. He explains that forceful breaking is less apt to cause cysts because the hemorrhage of the bone has an outlet into the soft tissues. In a closed bone where no fracture is present, when hemorrhage occurs the blood remains within and cysts are more apt to develop than in a bone where the hemorrhage is not incarcerated. There are two factors which explain why trauma is not recognized as the initial cause: (1) the type of trauma is such that it does not lead to fracture of the bone, and (2) the long intervention of time between the initial trauma and the obvious destruction of bone by the hematoma. von Haberer also presumes that the disproportion between the frequency of fractures as compared to the lesser occurrence of cysts may be explained by the following. Just as some people bleed on very slight trauma and others react similarly only to very much greater force, bone may also present that characteristic. The condition of the blood vessels, too (blood clotting ability, etc.), may be of significance. Again, all hemorrhages must not necessarily develop into cysts and it is probable that they do so only exceptionally. He feels that a great many rheumatic complaints, muscular and bony pains might possibly be due to bone hemorrhage.

In osteomalacia and osteoporosis the elasticity of the bone is much greater than in normal bone and therefore the occurrence of cyst and its multiplicity may be understood. In infantile scurvy Fränkel[16] has shown the occurrence of cysts. It is probable that in many instances where cysts are present there is a special tendency to hemorrhage which increases the tendency to cyst construction.

Cysts and brown tumors may occur in osteitis deformans Paget which according to Looser[14] is a very chronic osteomyelitis of unknown etiology which may affect part of a bone, the whole bone or many bones, and lowers the resistance of the affected part. It is always a local disease even if multiple and may affect normal as well as generalized skeletal disease. It is anatomically characterized by (1) fibrous marrow; (2) complete reconstruction of bone; (3) a concurrent simultaneous thickening of the affected bone part, which (4) shows no relationship with mechanical causes. Its cause must also be sought for in an irritating effect on the bones by perhaps a circulating chemical or bacterial factor.

Lang[17] agrees that osteitis fibrosa localized and generalized are not primary disease entities but secondary to osteomalacic, rachitic disturbances in calcification. Schmorl[18] finds that osteitis fibrosa is not always combined with florid osteomalacia or rickets. He does not deny, however, the possibility of its relationship to healed osteomalacia or rickets. On the basis of his studies he concludes that localized and generalized forms of osteitis fibrosa do not morphologically differ and that there are definitely evident transitions between the two.

From the preceding review it is evident that the pathogenesis, etiology and nature of bone cysts is by no means accepted as clear. We have then, in brief, various conceptions: (1) that they are degenerations of true tumors; (2) that they comprise a disease entity; (3) that they are associated with and part of the picture of what was called by von Recklinghausen a disease entity, osteitis fibrosa; (4) that osteitis fibrosa Recklinghausen and osteitis deformans Paget are variations of a similar pathological process, cysts being more intimately associated with the first and formed by softening of fibrous tissue in the

young skeleton; (5) that the occurrence of cysts is influenced or connected in some way with the endocrine system; (6) that localized osteitis fibrosa and the generalized form are different pathological processes; (7) that there is a transition from the localized to the generalized form of osteitis fibrosa which is not necessarily expressed on the basis of pathological bone, and (8) that osteitis fibrosa Recklinghausen does not comprise a disease entity but rather a symptom complex (cysts, brown tumors, fibrous marrow and bone reconstruction) which is an expression of trauma and is localized in a normal bone and generalized in pathologic bones (osteomalacia, osteoporosis, osteitis deformans). The last conception of Pommer and Looser has been accepted by us as the basis for our studies. Kienböck[19] calls these bone cysts expansive bone cysts and it would be well to consider them as such or even better still to think of them as expansive bone hemorrhages or expansive hemorrhagic cysts.

CLINICAL CONSIDERATIONS

The most frequent cause of pathological fracture in youth is bone cysts. Bloodgood[32] finds that when pathological fracture has occurred without any previous pain, swelling, or loss of function it is usually due to bone cysts (in juvenile patients) and to metastatic carcinoma in adults. He states, "The most common latent lesion of bone which is coming under consideration now is the bone cyst." Its recognition is, therefore, important and the necessity of frequent roentgen examinations of the bones becomes obvious. Weighing the clinical symptoms on the basis of our observations we can say the following. In general, cystic bone disease comes under examination as a result of a trauma. Thus a fracture or infraction may become obvious or none may be found. In another type of case there is no definite trauma or injury but a utilization of the affected part of the skeleton far above the physiological boundary. It becomes clear that no difficulties must necessarily have preceded the development of the cyst, i. e., the development may occur without pain. The occasional, accidental finding of cysts in patients who come for examination for some other condition also speaks for this. We conclude then that pain is not characteristic of a cyst itself but due to a laceration or discontinuity of the periosteum in the affected part.

Rarely is the patient aware of a slow swelling and deformity of the bone. When he does so, it is usually at an advanced age of the cystic growth and chiefly in the multiple (generalized) forms. Here, too, symptoms are present which are due to the basic, systemic disease, osteoporosis, osteomalacia, or in sites of osteitis deformans Paget.

ROENTGENOLOGICAL DIAGNOSIS

In the roentgen picture we divide the (expansive hemorrhagic) cysts which come into consideration into two groups: (1) solitary (localized) cysts, and (2) multiple (generalized) cysts. These two groups of cysts give roentgenologically characteristic pictures which, however, are similar.

1. *Solitary or Localized (Expansive Hemorrhagic) Cysts.* On definite, apparently predisposed sites of the skeleton, the roentgenogram shows areas of diminished density or transparency which are usually oval but may be circular or triangular in shape having slightly thickened marginal zones and a bulging or arching cortex inflated to varying degrees. The interior of the area varies. It is usually homogeneous and transparent with single dense stripes within the area due to remaining bone trabeculae or to septa. It resembles then a soap bubble in appearance. This is a unilocular type. It may, however, present varying degrees of locularization dependent upon the amount of destruction and number of septa present, so that it is multilocular and appears honeycombed or sponge-like. The bone then has lesions composed of roundish or oval areas of varying size closely adjacent to each other and separated from each other by paper-thin septa.

The sites of predilection are the diaphyseal ends and mainly the proximal humerus, the area of the great trochanter, proximal tibia, but other sites may also be involved. The cyst border toward the diaphysis is sharp, toward the epiphysis the cartilage becomes the border which is not passed. Extension into the epiphyses

does not occur as a rule. The periosteum shows no reaction. Roentgen examinations usually reveal a transverse coursing fracture split since the fracture is very frequently the first cause which necessitates examination. The fracture can appear either as a light space or as impacted fragments in the form of dense stripes along with which periosteal callous processes may be seen. Long observation permits the blowing up and enlargement of the area of transparency to be followed.

2. *Multiple or Generalized (Expansive Hemorrhagic) Cysts.* The localization and clinical symptoms are similar to those of solitary cysts and here, too, youthful skeletons are principally affected. In this form (multiple) the areas of transparency may extend to the joint surface and protrude into it. With further growth the cortex as well as the joint surface may be broken through, in contrast to the solitary form where this rarely occurs. This may be explained by the fact that the multiple form occurs in pathological (malacic, porotic) bone. Occasionally on single sites the areas of transparency become less clear and the septa become indistinct. Irregular, fine, cloudy shadows may appear in addition to these, which apparently are due to cysts which are partly infracted, and are healing with slight calcification. The brown tumors themselves do not permit a differentiation from cysts in the roentgenogram. The destructive process has a sharp margination toward the diaphyses and sometimes it consists of a sclerosed zone. Near the localized destruction there is a change in the structure of other parts of the skeleton, in the sense of a malacia, porosis or osteitis deformans Paget. The localized destructions are, to be sure, frequently covered or concealed by calcified callus.

DIFFERENTIAL DIAGNOSIS

The roentgenologic diagnosis and differential diagnosis of bone cysts have been described by Hansen,[50] Bloodgood,[32] Rottenstein,[51] Caan,[30] Parola and Celada,[52] Claes,[53] Achard and Thiers,[54] Nové-Josserand,[55] Haenisch,[56] Adler,[57] Fedder,[58] and others. Bloodgood emphasizes the importance of differential diagnosis of bone cysts from giant cell sarcoma, chondroma and myxoma. Hansen adds carcinoma metastases and myeloma.

In differential diagnosis must be considered the other type of bone cavities, infectious (osteomyelitis and tuberculosis), and central tumors. In the latter the chief ones are chondroma and sarcoma. Of lesser importance are carcinoma, myeloma and myxoma.

1. BONE CAVITIES OF INFECTIOUS ETIOLOGY

a. Tuberculosis.

Here there comes into consideration only the central form, that form in which through the medium of the blood stream a sequestrum is built in the metaphyseal, i.e., epiphyseal end. The demarcation of the sequestered bone area creates a closed cavity, the walls of which become gradually covered with a smooth membrane similar to the tuberculous lung cavity. The incipient contents consisting of sequestrum and purulent or caseous masses is slowly resorbed and finally replaced by a sterile pus, the cell content of which varies. Occasionally the fluid content is clear and has few cells so that it resembles the fluid contents of a cyst. Primarily then, only chronic tuberculosis comes into consideration.

The roentgen findings in chronic tuberculosis follow. In the diaphyseal end or protruding into the epiphysis, there is an area or site of transparency with smooth borders without shadow-creating contents. The borders of the wall may be built by a narrow sclerosed zone. The neighboring bone structure shows, as a rule, no evident rearrangement or increased density.* When the area of transparency lies near the periphery, the bone surface may show an arching which is caused by an ossification of the periosteum. The size and form may remain unchanged during years of observation. Special forms of tuberculosis, particularly the multiple spina ventosa may have a cyst-like character and a thorough study is often necessary to differentiate these two conditions.

* It is generally accepted that where there is a purely tuberculous infection, there is only slight, if any, reaction of new bone formation; where there is a secondary infection, however, by blood stream or locally (fistula) the bony reaction and new formation may be marked and, in fact, very rich.

b. Chronic Inflammatory Osteomyelitis. By this is commonly understood that disease which is caused by cocci of various types, usually streptoccoci and staphylococci. The thrombosis of a bone blood vessel leads to a necrosis of the areas supplied by that vessel. The necrotic tissue is gradually demarcated and may at first liquefy and later be resorbed. The roentgenogram shows the necrotic bone area as a transparent site because of its lack of calcium. According to its position in the bone section and according to its projection, this area of transparency can have varying size, form and intensity. The site may be round, oval, or triangular. A confusion with cysts is particularly possible when the immediate surroundings of this transparent area show no obvious sclerosed shell and when the periosteum shows as yet no ossification. That is particularly the case in central osteomyelitis where the condition is not old and where there is diminished proliferative ability of the skeleton (cachexia in the young and also particularly in the senile). As a rule, however, there is ossification around the osteomyelitic site and on the periphery of the bone, which simplifies the differential diagnosis. The clinical symptomatology of osteomyelitis plays, of course, an important rôle.

c. Syphilis.

In syphilis there may come into consideration certain types where the osteomyelitic area of destruction protrudes into the central layers of the bone.

The roentgen picture shows varying changes in two projections, one perpendicular to the other: anteroposteriorly, an area of transparency with sclerosed margination: laterally, a half circular, transparent area whose opening or excavation faces the soft tissues.

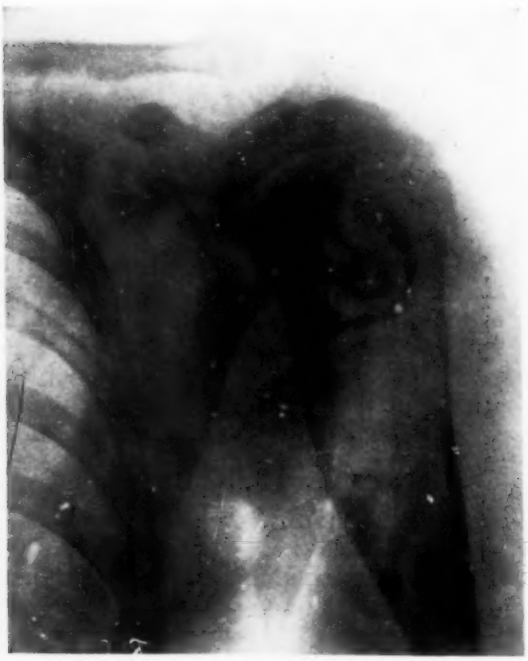

FIG. 1. Case I. Expansive hemorrhagic cyst (bone cyst) unilocular type.

FIG. 2. Case II. Expansive hemorrhagic cyst (multilocular type).

Differential Diagnosis. This disease does not frequently come into consideration since the periosteal ossification adjacent to the destruction speaks against cysts. Aside from that, gummas are rarely isolated, other parts of the skeleton showing similar changes. In congenital syphilis there may occur smooth-walled cavity spaces in the swollen diaphyseal ends which suggest the presence of cysts. They are differentiated from cysts by the ossifying periosteal thickenings.

d. Parasitic Cysts.

They will be mentioned but not considered because of their relative infrequency.

2. CENTRAL TUMORS

Central tumors come into roentgenological consideration for differential diagnosis because these solid calciumless tumors, like cysts, appear on the roentgen film as areas of transparency within the bone

FIG. 3. Case III. Bone cavity: infectious (osteomyelitic) origin. Lateral view.

shadow. In general, we are concerned with that group called slowly progressive central tumors, and the malignant form of central sarcoma.

In the group of "slowly progressive central tumors," are usually considered those tumors which occur in the diaphyseal ends which grow exceedingly slowly and remain solitary. The anatomical substratum may be varied; chondromatous, fibrous, sarcomatous, myxomatous. In the roentgenogram smoothly bordered areas of transparency, usually round, are seen. The marginal zones are frequently sclerosed, the cortex arching. This tumor group shows the greatest similarity to cysts from the standpoint of localization as well as the clinical course and the roentgen picture. There is here, however, practically always a definite sclerosis of the marginal zone and an arching of the bone surface with building of septa.

FIG. 4. Case III. Bone cavity: infectious (osteomyelitic) origin. Anteroposterior view.

Less difficult is the differentiation from malignant central sarcoma which also usually occurs in the diaphyseal end but grows much more rapidly. In the roentgenogram the area of transparency caused by this sarcoma is usually unsharply and irregularly bordered. There is no sclerosis of the marginal zone and no protrusion of the cortex. The surrounding bone is often atrophic. In the course of many observations within a short time a definite progression and frequently a breaking through the corticallis may be observed. Occasionally a slight periosteal ossification may occur.

In softened tumors in which the content is degenerated cavities are not recognized roentgenologically. As is well known cer-

Fig. 5. Case IVa. Bone cavity: infectious (tuberculous) origin.

tain chondromas and sarcomas come into consideration. On the same basis myxomatous degeneration cannot be diagnosed.

CASE REPORTS

Case I. *Expansive Hemorrhagic Cyst (Unilocular)* (Fig. 1).

Clinical. Sixteen year old boy who three days ago received a blow on his right shoulder but could move his arm normally immediately after the blow. For one day had marked pains in the right shoulder, with difficulty in lifting his arm. The right arm in its uppermost part is swollen and tender. Passive movement is normal. A previous trauma was not remembered.

Roentgenogram. The proximal one-third of the right humerus is inflated. The cortex is thinned and expanded in a spindle-like form which incloses a large area of transparency within which bone structure is absent. Within this transparent area single transverse crossing bone shadows are seen. There is an infraction underneath the greater tubercle.

Diagnosis. Solitary (expansive hemorrhagic) cyst.

Differential Diagnosis. Chondroma comes into consideration here. The uniform thinning of the corticallis, the concentric position and the inflation, the growth in the long axis of the bone are points against chondroma.

Operative Findings. The upper one-third of the humerus is found blown up. The periosteum immediately beneath the greater tubercle is hemorrhagically infiltrated. The bone is thin and smooth and through its very thin bony shell one enters a hen's egg sized cavity which is filled with serous, bloody fluid. The cyst was excochleated. Healing followed in six weeks.

Histological Diagnosis. Osteitis cystica juvenilis.

Case II. *Expansive Hemorrhagic Cyst (Multilocular)* (Fig. 2).

Fig. 6. Case IVb. Bone cavity: infectious (tuberculous) origin.

Clinical History. A man, aged thirty-eight, strong, always healthy who on lifting his right

arm experienced sudden pain, referred for roentgen examination as fracture.

Roentgenogram. The head and region of the surgical neck of the humerus are completely destroyed, the bone is displaced by a transparent tissue within which a dense trabecular scaffolding extends. The structure, therefore, appears honeycomb-like. The cortex is irregularly thin and distended. The region of the surgical neck is infracted. The destruction extends upwards to near the joint surface without involving it, however, and downwards to the metaphysis. The adjacent bone appears intact.

Fig. 7. Case IVb. Bone cavity: infectious (tuberculous origin.

Differential Diagnosis. In consideration here come benign and malignant central tumors, and cystic structures. The honeycomb structure, the uniform thinning and the displacement of the cortex, the lack of atrophy in the adjacent region speak against malignant sarcoma. Against benign tumors where also the cortex is thin and bulged the structure with its fine septa can only be used in differential diagnosis.

Operative Findings. The lateral corticallis of the surgical neck of the humerus was removed. In the hen's egg space there are many small spaces separated by bone trabeculae and filled with blood-tinged serous fluid.

Fig. 8. Case v. Central sarcoma.

Histological Diagnosis. Osteitis fibrosa localisata.

Case III. *Osteomyelitis* (Figs. 3 and 4).

Clinical History. A man, aged forty, who for many years has had slightly tender thickenings on the extremities. There is a history of his having had a febrile disease many years previously (typhoid fever).

Roentgenogram. Distal half of the right lower arm. In the region between the middle and lower thirds of the tibia there is a date-sized area of transparency. It lies slightly eccentric toward the volar side and comprises a part of the cortex and spongiosa. The contours are sharp. The area contiguous to the site is densified as a result of central sclerosis. The periosteum shows circular ossification. The area of transparency is similar to one caused

by solitary cysts, but it is differentiated by the very rich bone apposition in the neighborhood.

CASE IV*a*. *Tuberculosis* (Fig. 5).

Clinical History. A man, aged twenty-nine, who twelve years ago first had a swelling of the second metacarpal bone of the right hand. There was pain. Since then, he has had persistent fistulae. The finger is swollen, the skin is thinned and there are fistulous scars in the region of the second metacarpal bone. There is no pain now and the movement is free.

FIG. 9. Case V. Central sarcoma.

Roentgenogram. The distal shaft end of the second metacarpal bone on the right hand is distended to a spindle form which contains a hazelnut sized, smooth walled area of transparency. The corticallis is slightly thickened by periosteal reaction and is distended. On the radial side there is a fracture.

Diagnosis. This is a case of typical tuberculous spina ventosa. Cysts come into consideration here since the space presents characteristics of a cyst. As a matter of fact in operative opening of such cases a cavity with smooth walls and clear sterile fluid content is found.

Differential Diagnosis. The spina ventosa has a sclerosed and thickened wall while the cyst (solitary, unilocular cyst comes into consideration here) has a wall which is thin and as a rule well inflated. From the anatomical standpoint, however, the differential diagnosis may be difficult. The clinical symptoms are of particular importance to consider, chiefly localization, tenderness and skin changes.

CASE IV*b*. Another case (Figs. 6 and 7) which illustrates the difficulty sometimes met with in differentiating tuberculosis (of the diaphysis) from cyst follows: A boy, nine years old, who one year ago developed a swelling tenderness in the right tibia after jumping. A bandage was applied over this area. During the past year the pains have increased.

Roentgenogram. In the distal third of the right tibial diaphysis there is a plum-sized area of transparency with sharp outlines which

FIG. 10. Case VI. Osteochondroma.

show slight transgression over the epiphyseal border. The adjacent region shows an increase in density. There is periosteal apposition.

Diagnosis. The appearance in the roentgenogram of the area of transparency with its smooth walls in this juvenile skeleton suggests the presence of a solitary cyst. The reactive sclerosis of the adjacent bone, the periostitis and the transgression to the epiphysis speak against cysts and in favor of tuberculosis.

Operation. The cavity in the distal metaphysis of the tibia was curetted and membranous bloody tissue removed.

Histological Diagnosis. Tuberculosis.

CASE V. *Central Sarcoma* (Figs. 8 and 9).

Clinical History. A woman, aged fifty-five, was referred for roentgen-ray treatment because of a tumor on the calvarium. In the course of the treatment she complained of pain

in the left knee which became so marked as to cause inability to walk.

Roentgenogram. The distal metaphysis of the femur is completely destroyed, the bone being displaced by a circular tangerine-sized transparent tissue with sharp but irregular coursing contours. Within the area of transparency one can differentiate single remnants of cortex and spongiosa. The focus extends to the joint and appears to enter the joint in the region of the intercondyloid fossa. The medial cortex is broken through and largely resorbed. The adjacent bone is slightly atrophic. The periosteum is not changed.

Differential Diagnosis. The similarity to cysts consists in the type of the area of transparency, in the form, in the localization, and in the absence of appreciable reaction in the adjacent bone. The differences consist in the resorption of the cortex without evident thinning and displacement of the same. The absence also of a fracture with such a large sized focus speaks more for a tumor, the pain from which causes less mechanical use of the extremity and therefore exposes the part less to trauma.

Operation. Amputation of distal half of femur.

Histological Report. Spindle cell sarcoma.

Case VI. *Osteochondroma* (Figs. 10 and 11).

Clinical History. A girl, aged twenty-three, who for ten years without apparent cause has had a gradually enlarging swelling in the region of the second metacarpal bone. Within the last weeks there has been marked growth and tenderness. Underneath the second metacarpal bone there is a firm, cherry-sized, immovable swelling underneath normal skin.

Roentgenogram. The second metacarpal underneath the head is destroyed. A hazelnut sized, transparent, partly spotted swelling bulges dorsally and radially from within the bone. The cortex on the ulnar side is intact, that on the radial side is displaced and thinned. The adjacent bone is normal except near the proximal margin of the swelling where the cortex appears thickened.

Differential Diagnosis. Here we must consider cysts or soft tumors. In favor of cysts are the localization, the displacement and thinning of the cortex. Against cysts may be held the spotted character of the structure. Under the soft tumors the benign progressive or the malignant sarcoma comes into consideration. The displacement of the cortex without evident destruction and the structure speak against sarcoma. Considering the localization, chondroma (benign central tumors) first comes into consideration.

Operation. Resection of distal diaphysis of second metacarpal.

Histological Findings. Osteochondroma.

SUMMARY AND CONCLUSIONS

The term bone cavities has been suggested as comprehensive for the two groups of differing etiology: (1) Infectious (osteomyelitis, tuberculosis, syphilis and parasitic disease), and (2) hemorrhagic (expansive hemorrhagic cysts or bone cysts). The latter group has been considered in detail.

Fig. 11. Case VI. Osteochondroma.

Bone Cavities

Infectious Origin	*Hemorrhagic Origin*
Osteomyelitis	Expansive Hemorrhagic Cysts
Tuberculosis	(Bone Cysts; Osteitis Fibrosa)
Syphilis	
Parasites	

Fig. 12.

The term bone cyst is sharply defined only anatomically and pathologically and as such cannot be of complete use for a clinical or roentgenological diagnosis. Added to this is the difficulty that various pathologists do not accept a similar pathogenesis for cystic bone disease. It is necessary, therefore, that on the basis of the present pathological results and clinical and roentgenological considerations a classification be made, which can be used by the clinician and roentgenologist. The important factor, of course, in the recognition of bone cysts is the differential diagnosis from cyst-similar bone diseases. The roentgenological symptoms and particularly the clinical history are the basis for this.

In the present study this was attempted in the following manner: (1) The various conceptions by pathological anatomists of the genesis and classification of cysts from Virchow to the present time were considered. (2) The essential points in the clinical symptomatology were emphasized. (3) Significant roentgenological studies were considered. (4) On the basis of the preceding, and an intensive analysis of roentgenograms an attempt has been made to classify bone cysts so that a relatively unequivocal diagnosis may be made.

Our study shows that a purely anatomic division into false and true cysts is of little value practically, since in any event true cysts themselves are not very frequent and even those which are called true cysts are not so in the narrow pathological sense for these have no true secreting membrane. In the classification of bone cysts we have accepted the ideas of Pommer and Looser chiefly because they explain the changes in bone not only on a purely morphologic basis but also from the standpoint of physiological events, and it is only in such a way that a clarification will result here as in other bone diseases.

We have in general considered the three main divisions of cysts as they obtain in the literature: (1) The solitary cysts (osteitis dystrophia cystica von Mikulicz); (2) osteitis fibrosa localisata, and (3) osteitis fibrosa generalisata. There still exists considerable confusion in the interpretation of the relationship of these three groups to each other but especially in the extent of the relationship between the solitary cysts and what has been called osteitis fibrosa, whether the solitary cyst is a particular type of expression of this osteitis fibrosa. We consider all three types of a similar nature. What has been called osteitis fibrosa and solitary cysts are not disease entities but symptom complexes of expansive hemorrhagic cysts (brown tumors) accompanied by marrow fibrosis and bone reconstruction (umbau) in varying proportions. These are due to trauma and enhanced perhaps by an inferiority in the vascular system. As such this symptom complex may be solitary (localized) in normal bone or multiple (generalized) in systemically diseased bone (malacia, porosis) or in osteitis deformans Paget.

We have on the basis of clinical experience and particularly the roentgen findings considered bone cysts (and osteitis fibrosa) as expansive hemorrhagic cysts, this term being descriptive of origin and pathogenesis.

The roentgenological appearance may be unilocular (soap bubble-like) or multilocular (sponge or honeycomb-like) or present varying amounts of localization. The cortex may be expanded to spindle or ball form and is uniformly thinned. Periosteum and joint are broken through at times in the multiple form where the pathological state (lessened resistance) of the bone is the predisposing factor. Here, too, near the cystic lesions there are evidences of pathology in the sense of a malacia, porosis or osteitis deformans Paget. The diaphyseal ends of the long bones in the juvenile skeleton are the predilection sites.

In the clinical picture the pain is caused either through an interruption of the continuity of the bone or its elasticity whereby the laceration of the periosteum is the chief cause of the pain. Therefore, the site of the cyst is important to the clinical diagnosis. A cyst of varying character may remain unnoticed in the upper extremity whereas a similar cyst in a mechanically pressed bony part (lower extremity) will manifest itself clinically. Pain therefore, is not an expression of the cyst itself but mainly dependent upon its site. In the

multiple form symptoms of the basic disease (malacia, porosis, or osteitis deformans) will also be present.

Examples for diagnosis and for differential diagnosis are discussed. In the latter the bone cavities of infectious origin are considered and also central tumors.

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A FURTHER STUDY OF EMPHYSEMATOUS BLEBS*

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IN a previous contribution[1] I called attention to the anatomical and histological distinction between *blebs* and *bullae* as they occur in the human lung. It was there shown that a *bleb* was caused by a rupture of the pulmonary alveoli immediately beneath the pleura which allowed the air to escape into the pleura and caused it to separate from the underlying alveoli, thus forming a thin walled space situated outside of the lung itself; while in the case of a *bulla*, although the alveoli beneath the pleura were greatly distended, and eventually by the destruction of the interalveolar walls formed a large space that often projected beyond the level of the surrounding pleura, it was situated within the lung and was covered by the intact pleura. In other words, a *bleb* is an interstitial emphysema situated within the p'eura and causes those thin-walled, bladder-like prominences which are found on the surface of the lung; while a *bulla* is due to a vesicular emphysema situated within the lung and, though it often projects beyond the surface of the lung, is covered by an intact pleura.

Fig. 1. Lateral view of the larger of the blebs described in the text (×2).

[1] Miller, W. S. A study of the human pleuro pulmonalis: its relation to the blebs and bullae of emphysema. Am. J. Roentgenol. & Rad. Therapy, 1926, xv, 399–407.

* Aided by a grant from the National Tuberculosis Association.

At the time I published my previous paper I did not possess a gross specimen that showed in its entirety a bleb. Dr. Kennon Dunham, of Cincinnati, had furnished me with a block of lung that included the margin of a bleb, and I used it in describing the histopathology of a bleb. Since that time Dr. E. M. Medlar of the department of pathology in the University of Wisconsin, has placed at my disposal the left lung of a man, who died during an attack of asthma, in which well-marked blebs were present. The following abstract is taken from the protocol of the necropsy.

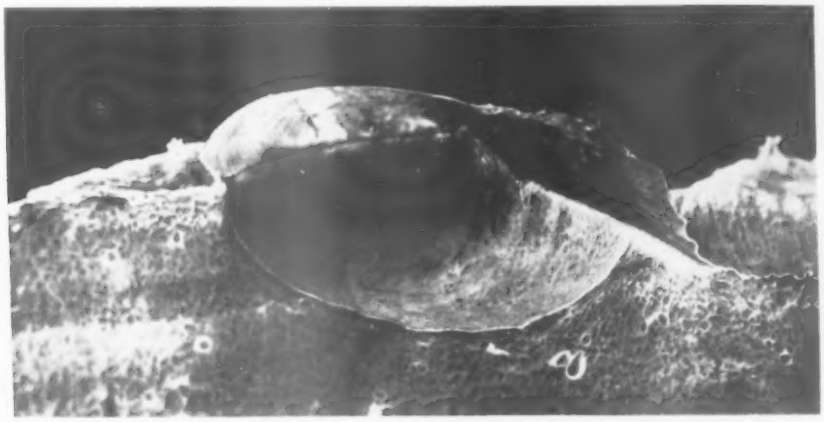

FIG. 2. The bleb shown in Figure 1 cut open (×2). For the description of this figure see the legend accompanying Figure 3.

Male, white, aged fifty-three. Suffered from chronic asthma and died during an attack. The right lung was rather large and had a puckered scar at the apex. The lung did not collapse on removal from the thoracic cavity. On section

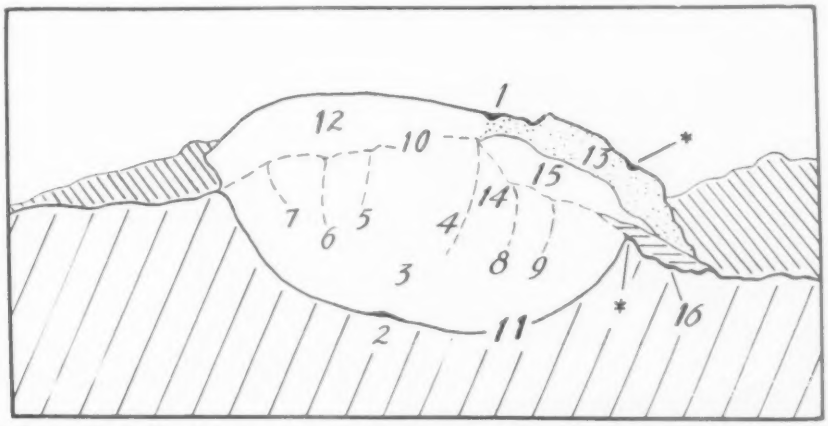

FIG. 3. Descriptive outline indicating the various points shown in Figures 1 and 2. 1, white line shown in Figure 1; 2, pigmented spot (lymphoid tissue); 3, cavity of the fully formed bleb; 4, 5, 6, 7, 8, 9, the position of septa which mark out secondary lobules; 10, outer edge of the lung in the primary bleb; 11, lower edge of the bleb; 12, thin lamella of the pleura which forms the outer wall of the bleb; 13, extension of 12 which has been peeled off from the lung by the secondary rupture; 14, point at which the second rupture took place; 15, secondary space formed by the air extending along the pleura, giving rise to the triangular area described in connection with Figure 1; 16, surface of the lung exposed by the extension on the bleb. The upper of the two stars indicates where the covering of the original bleb joined the intact pleura (lower star) before the extension of the bleb by the second rupture took place; it also indicates the place where the upper of the two grooves starting from the pigmented spot in Figure 1, arches over to the opposite side of the bleb.

An instructive study of Figures 1 and 2 can be made by using either a millimeter rule, or a pair of compasses, to identify the points indicated in Figure 3.

mucopurulent plugs were found in many of the bronchi. There were numerous areas of interstitial emphysema [blebs] in the pleura. On the anterior surface of the lower left lobe two small blebs evidently of recent origin, for they contained blood, were found. On the mediastinal surface there was a well-marked bleb 33 mm. in diameter. The left lung was the only one that I personally examined, the right lung having been used for student demonstration at the necropsy.

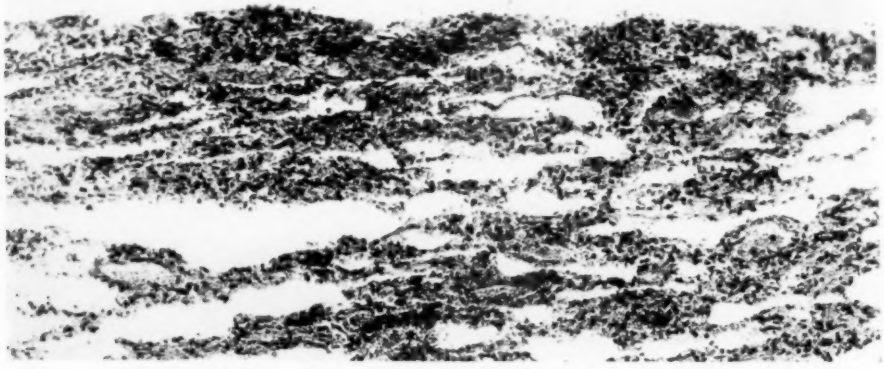

FIG. 4. Compressed lung tissue underlying the bleb shown in Figure 2 (×100).

Of the three blebs found on the surface of the lower lobe of the left lung the largest, as stated in the protocol of the necropsy, was situated on the mediastinal surface; it was 33 mm. in diameter and projected 8 mm. beyond the level of the surrounding pleura (Fig. 1). A little to the right of the center of the bleb and arching over its anterior surface a white line can be seen which is continued by an indistinct groove to the small pigmented spot situated just below the base line of the bleb.

If the line of demarcation which marks out the base of the bleb from the surrounding pleura be followed to the right it will be seen that, above the small pigmented spot near the center of the line, it divides into two arms which enclose between them a triangular area. The upper arm forms a well-defined groove, while the lower arm continues the base line until it meets the curved surface of the bleb. Between these two arms there is a rounded triangular area which was not easy of interpretation. That it contained air could be readily demonstrated, and that it communicated with the larger cavity seemed certain. The possibility that the air in the original bleb had begun working its way along the pleura, in a manner similar to the blood in a dissecting aneurysm, suggested itself; but this could be demonstrated only by cutting the bleb open.

On cutting the bleb open an interesting condition was found (Fig. 2) which is best explained by means of the outline drawing (Fig. 3). The white line seen in Figure 1 arching over the surface of the bleb is found on section (Fig. 3, 1) to be the surface marking of a septum which had been ruptured by the extension of the bleb along the pleura. It is quite probable that at first the bleb was a small one and extended between the septa marked 4 and 5 in Figure 3, or in Figure 1 between the white line and the slight depression 15 mm. on its left; for this corresponds to the distance

FIG. 5. The thin lamella of the pleura which forms the outer wall of the bleb in Figure 2 (×100).

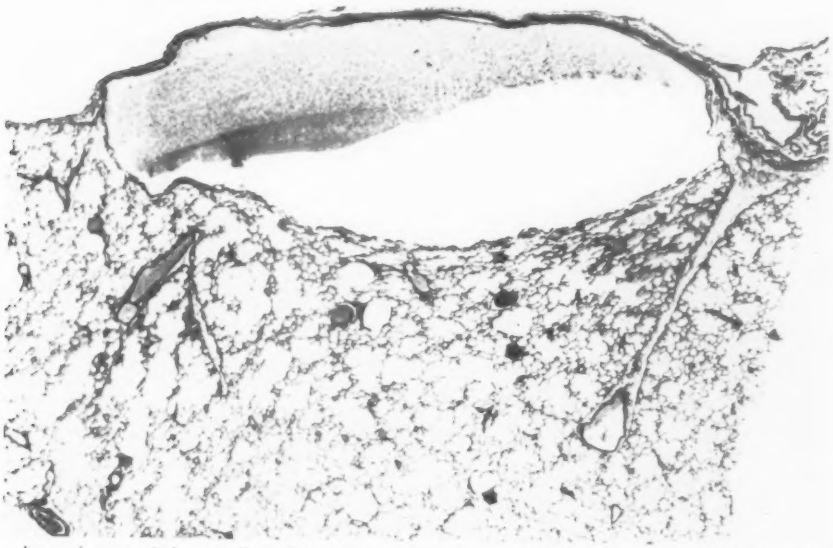

FIG. 6. Section through one of the smaller blebs showing the recent hemorrhage into the bleb (×8). Note that the extension of the bleb has been arrested by the septum on the right of the figure. It is probable that the bleb shown in Figures 1 and 2 was temporarily arrested by a similar septum.

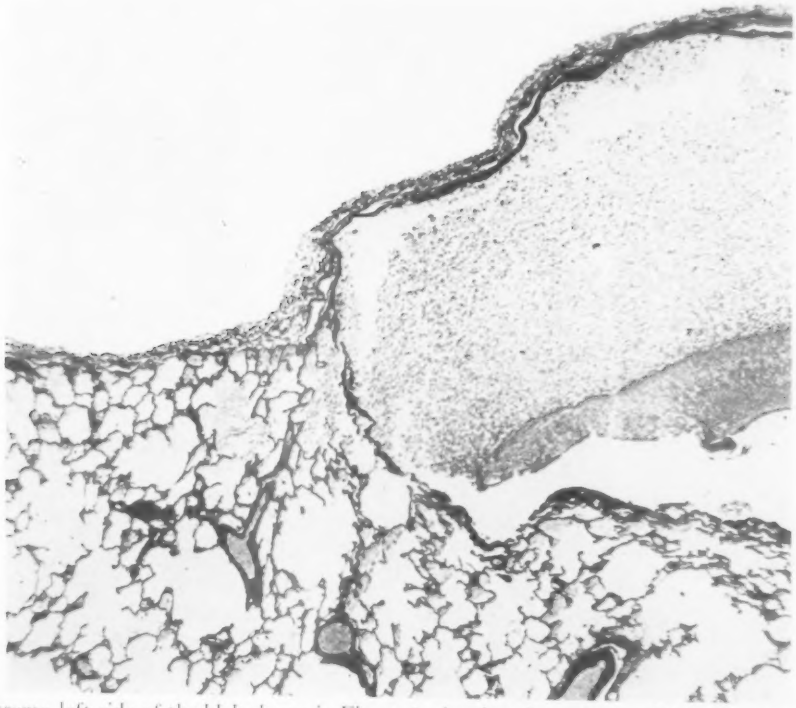

FIG. 7. The extreme left side of the bleb shown in Figure 6, showing the torn alveolar walls and the source of the hemorrhage into the bleb and into the alveoli. The hemorrhage probably came from capillaries connected with the branch of the pulmonary artery which can be seen extending obliquely into the hemorrhagic area (×25).

between the corresponding septa in Figure 2, and between 4 and 5 in Figure 3.

For the time being the septa indicated by the white line remained intact and the bleb extended to the left by the successive rupture of septa 5, 6, and 7 in Figure 3. In process of time the septa indicated by the white line gave way; and the bleb extending to the right caused the rupture of septa 8 and 9 in Figure 3, thus forming the bleb as it existed at the time of the necropsy (Figs. 1 and 2). Eventually the alveoli gave way for a second time (Fig. 3, 14), and the outer lamella of the pleura was still further peeled off from the lung (Fig. 3, 13). This gave rise to a new space (Fig. 3, 15) that communicated with the original bleb (Fig. 3, 3) and at the same time began to extend along the surface of the lung (Fig. 2). This second rupture of the alveoli and the extension of the bleb along the surface of the lung must have been of recent origin, for the air spaces beneath it are but slightly compressed. It is this extension of the original bleb which, as already stated, resembles a dissecting aneurysm, that caused the triangular elevation between the two grooves seen in Figure 1. An extended search failed to demonstrate the point where the original rupture took place, but the place of the secondary rupture is clearly indicated.

The alveoli underlying a bleb which has existed for some time are compressed by the air contained in the bleb (Fig. 4). The age of the bleb and the tension of the air contained in the bleb, are the factors which determine the amount of the compression. The same factors influence the thickness of the separated lamellae of the pleura which forms the outer wall of the bleb (Fig. 5).

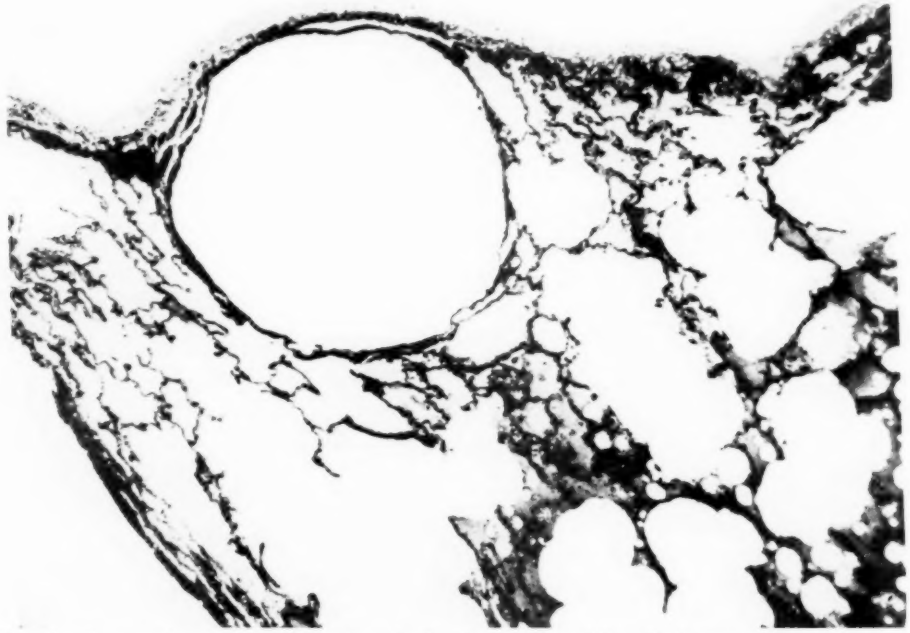

Fig. 8. The circular opening in this figure is a bulla. It is covered by the intact pleura and surrounded by emphysematous air spaces. The thin layer of compressed air spaces in the extreme left of the figure formed a part of the floor of a bleb (×40). Compare this figure with Figures 10 and 11 in my previous paper (see footnote).

The two smaller blebs described in the protocol of the necropsy had the same diameter, one centimeter; they projected 1.5 mm. above the level of the surrounding pleura. That they were of recent origin was shown by their containing freshly extravasated blood (Fig. 6), and by the alveoli underlying the blebs being but

slightly compressed as compared with those beneath the larger bleb. The point of the rupture of the alveoli and the source of the hemorrhage in the bleb illustrated in Figure 6, is shown in Figure 7. The figure also shows that the alveoli immediately connected with the rupture likewise contain blood.

The condition of the alveoli surrounding a bulla differs from those underlying a bleb. In the case of a *bulla*, owing to the accompanying emphysema, they are more or less distended, while in the case of a *bleb* they are more or less compressed. A fortunate series of sections from one of the smaller blebs brings out this differentiation in a single section (Fig. 8). The circular opening in the center of the figure is a portion of a bulla, and the accompanying emphysema is well shown; while the compressed alveoli on the left of the figure form part of the inner wall of a bleb.

PERFORATED ULCER SIMULATING DIVERTICULUM OF THE STOMACH*

BY EUGENE FREEDMAN, M.D.

CLEVELAND, OHIO

IN the case of perforated gastric ulcer here reported, the size and situations were so unusual that the roentgenological findings were thought to indicate a diverticulum. Many cases of gastric diverticula are reported in the roentgen-ray literature, but with the exception of two cases (Borszéky), we were unable to find ulcers described which closely simulated diverticula and the pathogenesis of which was proved by operation or autopsy. Most of the cases which are diagnosed as diverticula are not operated upon and the question of etiology and pathogenesis remains unanswered. We were able to follow our case and correlate the roentgenological findings with the operative and autopsy findings.

CASE REPORT

Mrs. J. A., aged sixty-nine, housewife, was admitted to the Medical Service of the Lakeside Hospital on August 16, 1926, complaining of pain in the abdomen. For two years the patient had been troubled with intermittent abdominal pain and during this period she had lost about 90 pounds. She had been confined to bed most of the time during the preceding nine months and continuously during the four weeks immediately prior to her admission. Since November, 1925, she had had occasional attacks of vomiting; the vomitus was mucoid, and neither particles of food nor blood were observed in it. Previous to the present sickness the patient had never been seriously ill.

The physical examination revealed a poorly developed and poorly nourished female, with marked deafness of both ears. The lungs and heart were essentially negative. There was visible peristalsis in the epigastrium passing from the left to the right. There was a great deal of tenderness in the left upper quadrant, but no mass was palpated. Examination of the blood on admission showed 11,200 W.B.C., 3,500,000 R.B.C., 30 per cent Hb (Dare); the smear was normal. The urine was essentially negative. The examination of the gastric contents showed brown colored particles of food and much mucus, so that it would not strain through gauze. Free acid, absent; total acidity, 18; benzidin, ++. The microscopic examination showed numerous leucocytes and a few epithelial cells. Clinical impression: carcinoma of the pylorus.

Roentgen-ray studies of the gastrointestinal tract were as follows: "The stomach occupies a low position, is of fish-hook type and somewhat dilated. Its tonus is fairly good; the peristaltic waves are vigorous at times. Upon examination with the patient in an erect position a curious semicircular shadow is seen on the greater curvature of the fundus of the stomach, the outline of which is regularly defined. Because of its location under the costal arch, palpation is impossible (Fig. 1).

"The examination in the right lateral and slight Trendelenburg position reveals a circular

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sac, about 7 cm. in diameter, which seems to communicate with the stomach through a large opening. The lower, anterior quadrant of this sac is irregularly defined, which appearance is constant. There are some irregularities on the cardiac end of this sac and on the cardia of the stomach, which, however, are not constantly seen and are regarded as peristaltic waves (Fig. 2).

"The examination after six hours shows a retention in the sac, which has become completely visualized and shows irregularities on its medial and lower wall also. The rest of the stomach is empty at this time (Fig. 3).

"The examination at eighteen hours still shows some retention in the previously mentioned sac (Fig. 4).

"The rest of the gastrointestinal tract seems negative."

Due to the peculiar situation of the sac (on the posterior wall near the greater curvature), the prolonged retention and its large size, the possibility of a perforated ulcer was not taken into consideration. The findings were interpreted as being due to a gastric diverticulum, and the irregularities on its anterior and medial wall, together with the loss of weight and emaciated condition of the patient, were thought to be possibly due to a malignant degeneration in the wall of the diverticulum.

Roentgen films of the patient's stomach could not be taken, because she was unable to coöperate, and roentgenoscopic examination only was made. Because of the patient's serious physical condition an exploratory laparotomy was advised, but the patient refused to submit to this and went home.

Six days later the patient was readmitted to the Surgical Service. Since her discharge she had had constant severe pain, had vomited a great deal and had not been able to sleep because of the pain. At this time examination of the blood revealed 12,000 W.B.C., 4,200,000 R.B.C. and 42 per cent Hb (Sahli).

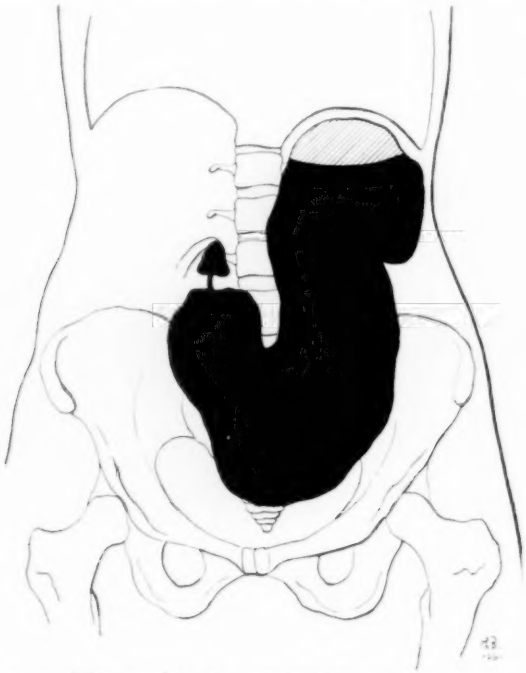

Fig. 1. The semicircular projection on the greater curvature near the diaphragm.

Fig. 2. With the patient in right lateral and slight Trendelenburg position the circular sac on the posterior wall of the stomach with irregularities on the anterior lower quadrant is shown. The irregularities on the cardiac end of the stomach are due to peristaltic waves.

An exploratory laparotomy was performed by Dr. Allen Graham after a transfusion of 500 c.c. of whole blood. The stomach was found to be large, and there were numerous adhesions on the anterior surface. Further exploration revealed a lesion just below the junction of the esophagus on the greater curvature and posterior wall. This lesion extended toward the left and was thought to be a fairly large diverticulum, the tip of which was adherent to the spleen. The diverticulum at its origin from the stomach had a fairly wide orifice, easily admitting three fingers. The

wall of the stomach at this point was quite markedly indurated, but the induration was apparently inflammatory rather than neoplastic. In view of the fact that the lesion could not be mobilized, a longitudinal incision was made in the anterior wall of the stomach for the purpose of exploring the lesion from within, but the lesion could not be exposed to view. The anterior wall was closed, and the diverticulum was approached from outside in the hope of isolating it from the stomach and closing the latter. On opening the diverticulum at its point of origin, a large cavity filled with a papillomatous growth was brought to view. Even after opening the diverticulum, it was found impossible to free the lesion from the posterior wall, the spleen and the pancreas. It was therefore decided to close the opening into the diverticulum, and in view of the probability of infection iodoform gauze and cigarette drains were inserted along the anterior wall of the stomach and the abdominal wall was closed.

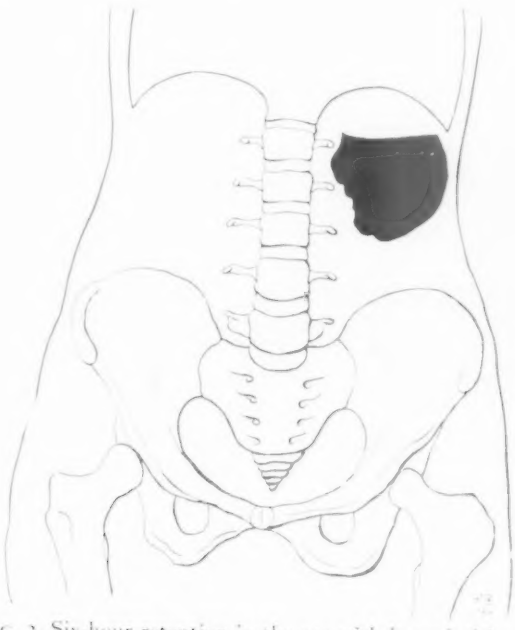

FIG. 3. Six-hour retention in the sac with irregularities on the medial and lower wall.

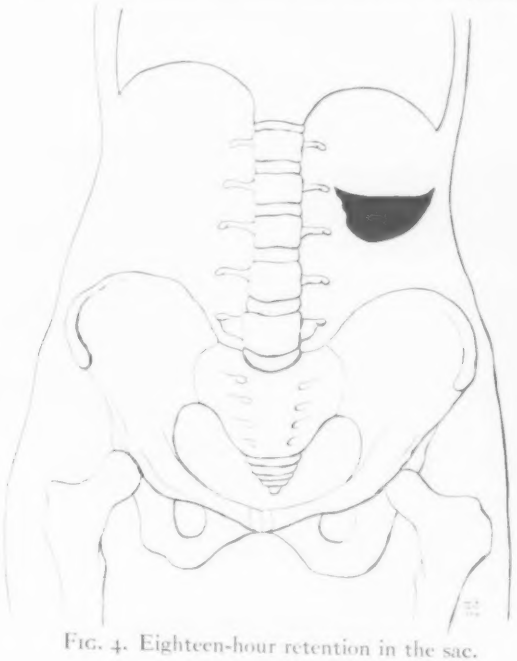

FIG. 4. Eighteen-hour retention in the sac.

Postoperative Course. The patient became gradually worse after the operation and complained of continuous cramping pain in the left upper quadrant and the left chest; on the second day auricular fibrillation was noted. On the third day after the operation she developed a friction rub at the left base. The temperature was 38.2°C. and W.B.C. 18,500. On the seventh day after the operation a gastrostomy opening was made near the pylorus by Dr. Graham with a cautery, and a duodenal catheter was inserted and duodenal feedings were started. These were unsuccessful, however, as the feedings were regurgitated into the stomach and out around the catheter into the wound. Following this the patient became gradually weaker and died on the ninth day after the operation.

Abstract of the Autopsy Findings (Drs. Lebowich and Benischek): "The posterior wall of the stomach near the cardia and greater curvature is in connection with an abscess sac the size of a small apple, which is walled off by the spleen, pancreas, diaphragm and by chronic inflammatory tissue. There is a hole on the posterior wall of the stomach measuring about 4 cm. in diameter, which communicates with the abscess sac. The mucosa of the stomach is markedly hypertrophied at the neck of the sac. A papillomatous growth about 4 by 2 cm. in size is rising from the right side of the free edge of this opening in the stomach. This tumor leaves the cavity of the stomach through the above described hole and is situated in the abscess sac near the tail of the pancreas. It is dark red in color, very soft and shows a slight thickening on its base. The wall of the stomach is generally thicker than it is normally. There is a recent suture wound on the anterior surface near the pylorus, and a gastrostomy wound near the suture wound.

"Sections of the stomach from the free edge

of the hole show histologically a loss of the mucous surface, with superficial deposit of a thin layer of necrotic material. Directly beneath there is an extensive deposit of dense, fibrous tissue in the mucosa, which extends laterally and is associated with some new-formed young blood vessels, and numerous foci of lymphoid cells, frequently disposed about the blood vessels. The fibrous tissue also extensively invades the muscularis, with wide separation of the muscle bundles. The continuity of the serosa is also broken off at each end of the ulceration. Sections of the papillomatous growth show a sudden transition of the normal mucosa into a tumor growth, composed of enlarged, irregular and tortuous glands, lined with cylindrical epithelium. Mitotic figures are extremely uncommon. Some of the gland lumina contain pink staining mucus. The stroma between the glands is slight in amount, loose in character. The submucosa is thickened by an excess of fibrous tissue and extends upward in the tumor.

"Autopsy Diagnosis. Chronic gastric ulcer with perforation; adenoma of the stomach; perigastric abscess, localized peritonitis."

DISCUSSION

A diverticulum has been defined by Akerlund as a circumscribed, more or less rounded, pocket or bag-shaped protrusion from the gastrointestinal tract. Diverticula are divided into two types—the true and the false diverticula. The false diverticulum is a localized protrusion of the mucous membrane through a defect in the muscular coat, and the true diverticulum is a localized protrusion of the entire wall. The diverticula occurring after traumata, operative procedures (as near the gastro-entero-anastomotic stoma, Béclère's and Akerlund's cases), and through pressure from foreign bodies or traction from outside are designated as acquired diverticula. The diverticula of unknown origin are regarded as congenital. In a few cases of gastric diverticula pancreatic tissue has been found at the base of the diverticulum, and these diverticula have been considered to be due to developmental defects (Heubel, Nauwerck).

The occurrence of gastric diverticula is very rare in comparison with the occurrence in other parts of the gastrointestinal tract. They seem to have a predilection for two places in the stomach, namely, around the cardia and within the pyloric antrum. Their size varies generally from that of a small pinhead to that of a pigeon's egg; however, diverticula which attained larger sizes have been described.

That a pocket or bag-shaped protrusion from the wall of the stomach, seen after the barium meal, is not necessarily a diverticulum is well illustrated by the case reported here. A perforated gastric ulcer with a walled off abscess sac and smooth outlines may produce the same roentgenological appearance, and it is sometimes impossible to differentiate the two conditions, especially if the lesion occurs near the pylorus, which is a common site of both ulcer and diverticulum. In comparison very few ulcers are found at the cardia, which is the other site of predilection for gastric diverticula. This fact, however, should not be considered as a definite proof against a perforated ulcer, because, as our case shows, despite its rarity ulcer occurs near the cardia and, if perforated, may simulate in appearance a diverticulum.

A few points of differentiation are mentioned in the literature: the smooth contour, the tendency of prolonged retention and the absence toward tenderness in a case of diverticulum as contrasted with the irregular contour, presence of tenderness and comparatively rapid emptying in a case of ulcer. However, these points are not always sufficient, because a perforated ulcer may also be walled off with smooth outlines and may retain the barium for a considerable interval. In a case where the ulcer is situated at the cardiac end of the stomach it is inaccessible for palpation, and the degree of tenderness cannot be appreciated as an aid in the differentiation.

The patient's clinical history should, of course, be taken into consideration, although this may be deceiving. Brown's case, mentioned by Tupper, gave a history of vomiting fresh blood four times, and the roentgenological examination revealed evidence thought to indicate a penetrating ulcer on the lesser curvature; operation, however, proved it to be a true diverticulum. In our case the considerable loss of weight, the emaciation of the patient, and the low acidity, combined with the

irregularities in the wall of the supposed diverticulum, were thought to be more suggestive of a malignant degeneration of the wall of a diverticulum than of a perforated ulcer.

Borszéky in 1914 described two somewhat similar cases which he considered were perforated gastric ulcers. One of his patients showed at operation a diverticulum the size of a small apple near the pylorus on the greater curvature. The layers of the stomach were thickened at the neck of the diverticulum, the covering serosa seemed slightly inflamed and there were a few perihepatic adhesions present. The roentgenological examination, performed previous to the operation, did not reveal anything except hyperperistalsis. The other patient did not have roentgen-ray examination, and the operation showed a walnut-sized diverticulum on the greater curvature near the pylorus. The serosa of the diverticulum was not thickened, but the layers of the stomach at the neck of the diverticulum were hard and thick. In both cases the diverticula were inverted, the serosa sutured and gastro-entero-anastomosis performed.

CONCLUSIONS

This case is reported to call attention to the difficulties which occur in the differentiation between gastric diverticula and perforated gastric ulcers. In this case the abscess sac was situated on the posterior wall of the cardia of the stomach near the greater curvature, and its roentgenological appearance was thought to indicate a diverticulum with malignant degeneration. The autopsy proved, however, that the diverticulum-like appearance was due to a perigastric abscess sac and the irregularities of the wall of the supposed diverticulum were due to a benign adenoma growing from a free edge of the ulcer. It is possible that some of the diverticula reported in the literature, without operative or autopsy confirmation, were due to perforated ulcers.

We wish to express our thanks to Dr. Allen Graham for his kind suggestions and to Miss Theodora Bergsland for the drawings.

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A CASE OF INFECTIOUS ILEUS OR PSEUDO-MEGACOLON (HIRSCHSPRUNG)

BY BENJAMIN M. BERNSTEIN, M.D.

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THE case herewith presented, is one that merits careful consideration because it is rare and is also of considerable practical importance. We are not here concerned with that fairly well-known condition of congenital megacolon first described by Hirschsprung in 1886. Our case, though not of this group, shows the one predominating feature of this entity—enlargement of the colon—and therefore the use of the term "pseudo-megacolon" (Hirschsprung).

FIG. 1. First examination. Roentgenogram taken after barium enema.

History.—G. A., male, aged sixteen, referred to us by Dr. Lerner in June, 1926. The boy had been perfectly well until three days before we saw him. His present illness began with slight cough, malaise, marked constipation which resisted catharsis and enemata, and vomiting. He had a temperature of 101°F. In appearance, he was asthenic, his abdomen was distended rather markedly, he seemed toxic and showed some diffuse râles in the chest. There was no adenopathy; no cardiovascular or other lesion was discoverable. Suspecting that we might be dealing with a pulmonary tuberculosis and a secondary tuberculous peritonitis, we made a roentgen examination of his chest and his colon. The accompanying illustration (Fig. 1) will show what we found at this time. Within twenty-four hours after the roentgenographic study, the temperature was normal, the abdomen was flat, the patient had had several good bowel movements and he was seemingly well. Six weeks, and again ten weeks later we made a roentgen examination of his colon and found an apparently normal colon (Fig. 2). At the present time, the boy is apparently in excellent health.

FIG. 2. Roentgenogram after barium enema; six weeks after first examination.

From our study of the chest and the roentgenograms of the colon we find that (1) there is no evidence of pulmonary tuberculosis; (2) the colon as filled with the barium enema at the first examination, is certainly tremendously enlarged for a man of any size, particularly so in a boy of sixteen; (3) there is no evidence of obstruction by growth, constriction, kink, band,

adhesion or spasm; (4) the enlargement is diffuse and general, extending from ileocecal valve to rectum; (5) the size and general appearance of the colon at the subsequent examinations is perfectly normal, with perhaps some increase in the proximal colon to the hepatic flexure, an observation which is not without great significance.

The first film made of this case (Fig. 1) seemed to justify a diagnosis of Hirschsprung's disease. The boy, however, was sixteen years of age, had never been constipated and his abdomen had always been flat. Practically all of the reported cases of Hirschsprung's disease and those which I myself have seen have been observed in children, generally not more than a few years old. The films taken six and ten weeks later proved conclusively that the case is one of pseudo-megacolon and not true Hirschsprung's disease.

I have been able to find in the literature a report of only one similar case. Bézy[1] has reported a case of markedly distended colon in a child aged four who was suffering from fever, vomiting and prostration. The symptoms were such that a lumbar puncture was done to rule out a possible meningeal lesion. The barium enema revealed a marked increase in the size of the colon confined to the proximal half or two-thirds. Surgical intervention was refused and the child recovered under medical treatment. A second roentgen examination of the colon showed no evidence of enlargement. Elzas[2] also reported a case of enormous dilatation of the colon of a temporary nature which he calls pseudo-ileus and which he ascribed to an anaphylactic state because of blood in the stools and subcutaneous hemorrhages accompanying the condition.

My impression of the case here presented is that we are dealing with a paresis of the colon, a paralytic ileus of infectious origin. This may also be the true explanation of Bézy's case. This type of ileus is sometimes found in typhoid fever, pneumonia, and other severe infections, and it may occur in other infectious conditions and remain undetected.

This case is offered for study and criticism, with a tentative diagnosis of infectious ileus.

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THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

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Information of interest to all readers will be found on page ii.

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Twenty-eighth Annual Meeting: Montreal, Can., Sept. 20–23, 1927.

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PRESIDENT OF THE AMERICAN ROENTGEN RAY SOCIETY

1927-1928

EDITORIALS

DOSIMETRY IN ROENTGENOTHERAPY

THE discussion of the more important dosage methods and units in a recent editorial[1] requires a supplement directed to the practical aspects of dosimetry. It seems desirable to outline the minimum requirements for a dosimetry which conforms to our present conception of how roentgenotherapy should be carried out.

Unfortunately, there exists a method which is said to enable the roentgenologist to calculate a dose if certain factors such as kilovoltage, tube current, focal skin distance, filter and size of field are known. I say, unfortunately, because this formula like any other, is so tempting through its simplicity that it is difficult to convince everyone of its inaccuracy. It cannot be over-emphasized, however, that one of the greatest advances in the physics of radiation will be made in furnishing proof that there is no formula which will hold true for every apparatus and tube, or will check within reasonable limits of error with the results of ionization measurements. The question arises, therefore, as to who shall measure the roentgen energy delivered by a tube, and what method and unit shall be chosen. With the better training of our future roentgenologists, there is no doubt that they will all be able to calibrate their apparatus by performing a number of simple ionization tests. Even the practicing radiologist whose time is almost entirely taken up by his daily work can acquire the knowledge and find the necessary time to carry out these measurements himself. It is also feasible to arrange with a well-trained physicist for a regular checking of the apparatus; eventually, manufacturing concerns may be able to provide a "standardization service."

Complete data regarding any roentgen-ray treatment should give the kilovoltage, tube current, focal skin distance, filter, size of field, diameter of part treated, time of application, the energy administered, and a factor expressing the quality (penetration) of the radiation. For his own personal use, the radiologist ought to know the percentage depth dose of the radiation, which means, for instance, the percentage of the surface dose which reaches 10 cm. depth in the body. On this basis, he can select some of the isodose charts recently published (Glasser, Stenström) and obtain a fairly exact idea of the roentgen-ray intensity as distributed in the tissue (body dose). The majority of the other data mentioned are easily found; the kilovoltage should be measured by a sphere gap complying with the specifications of the American Institute of Electrical Engineers. As indicator of the quality (penetration) of the radiation, the writer believes that the effective wave length (Duane) offers the most practical solution. The only calculation connected with this procedure is to figure out the percentage of the transmission through a given absorbing material. The effective wave length can be read off Duane's chart.[1] An electroscope suitable for such measurements is, for instance, the one designed by Dessauer; a well-insulated and fairly constant ionometer like the Wulf ionometer, is in the writer's experience another instrument of choice. There may be other models of this type of measuring apparatus available but these two are mentioned because they have been in use long enough so that their reliability is established. The percentage depth dose cannot be measured with an electroscope. An ionometer or iontoquantimeter with a small ionization chamber is required for this purpose. Wax or water may serve as phantom as either one absorbs roentgen rays to nearly the same degree as tissue. This measurement is not, however, absolutely necessary because with a given quality of radiation, the depth dose can be read off one of the isodose charts measured on an

[1] Dosimetry in roentgenotherapy. Am. J. Roentgenol. & Radium Therapy, January, 1927, xvii, 104–107.

[1] Am. J. Roentgenol. & Rad. Therapy, 1922, ix, 88–89.

American apparatus. That is accurate enough for practical purposes.

The greatest difficulty is presented by the recording of the quantity of radiation inasmuch as the roentgen unit and electrostatic unit, which are the only acceptable units, are hard to define. This can be overcome by having the ionization instrument calibrated in roentgen units. There are enough facilities now available to have this done. It is hoped that the time is not far distant when that calibration can be carried out in the Bureau of Standards. The fact that American, French, and German units do not agree certainly should not stand in the way of using a definite unit. If all the roentgenologists in this country will use the American roentgen unit, their doses will be comparable no matter what degree of erythema the individual radiologist may choose. The old definition of an erythema needs correction already, because recent investigations have shown that there is not one erythema, but the reaction appears in several cycles or periods. That the degree of erythema is subject to individual opinion has been explained in the first article.

One condition which is far from being ideal remains unsolved today. Even if all the necessary data have been established, we are not positively sure that during a given time, the desired dose is administered. All ionization instruments measure the dose per second and based on these figures we calculate the treatment time. During the treatment uncontrollable and unavoidable fluctuations may occur in the apparatus and alter the amount of roentgen energy which we expected to apply. The construction of a reliable integrating dosimeter recording the dose during the whole treatment on the patient is the only solution. A number of such instruments have been constructed on the Continent but no final judgment as to their real value can be offered at present. This incompleteness in our dosage methods is no excuse, however, for not making use of every improvement that physical science has provided for us. As long as we believe that it is important to know how much roentgen energy we administer to our patients and as long as it is desirable to have this dose reproducible, the above-mentioned measurements should be carried out.

The respective data in condensed form are as follows:

1. Kilovoltage (measured with sphere gap).
2. Tube current in milliamperes (two meters in the circuit).
3. Focal skin distance, size of field, diameter of part treated.
4. Filter.
5. Treatment time.
6. Lambda effective (quality of radiation measured with an ionization instrument).
7. Number of roentgen units delivered by a tube per second or per minute for a given quality (ionization chamber in air).
8. Number of roentgen units administered.
9. Number of roentgen units chosen as erythema dose (different for each quality of radiation; ionization chamber on patient).
10. The depth dose percentage and body dose if possible.

To some readers these minimum requirements in dosimetry may seem revolutionary or too scientific. It is a great satisfaction, however, to note that a steadily increasing number of roentgenologists are adopting these rules and carrying out their work on a sound scientific basis. ERNST A. POHLE, M. D.

SECOND INTERNATIONAL CONGRESS OF RADIOLOGY

Stockholm, July 23–27, 1928

We desire to call special attention to the announcements on pages iii and 67 of this issue of the Journal of the Second International Congress of Radiology to be held in Stockholm, July 23–27, 1928.

The First International Congress which met in London in 1925 decided that the Second International Congress would meet in Sweden in 1928 under the presidency of Professor Gösta Forssell. The success of the first Congress and the high standing and well-known ability of Professor Forssel and the members of the Swedish committee of management assure the success of the second Congress.

Our readers are urged to make plans to attend the Congress next year and to send in their registration at an early date, a blank for which is provided with the above-mentioned announcement on page iii.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. Charles L. Martin, Dallas, Texas.
Twenty-eighth annual meeting, Montreal, Can., Sept. 20–23, 1927.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. Fred M. Hodges, 801 West Grace St., Richmond, Va.
Annual meeting, Minneapolis, Minn., 1928.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. Robert J. May, St. Luke's Hospital, Cleveland, Ohio.
Annual meeting, New Orleans, La., Nov. 28–Dec. 2, 1927.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. E. C. Samuel, New Orleans, La.
Annual meeting, Memphis, Tenn., Nov. 14–17, 1927.

BUFFALO RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.
Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. R. A. Arens, Michael Reese Hospital
Meets monthly on second Thursday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. James H. West, 8314 Euclid Ave.
Meetings are held at 6 o'clock at the University Club, on the fourth Monday evening of each month from September to April, inclusive.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. Henry L. Ulbrich, 1130 E. Grand Blvd.
Meets monthly on second Friday from October to May, at Wayne County Medical Society Building.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. M. C. Sosman, Peter Bent Brigham Hospital, Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. W. W. Belden, 8 West 16th St.
Meets monthly on second Monday, New York Academy of Medicine.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.

ROENTGEN RAY SOCIETY OF CENTRAL PENNSYLVANIA
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary, Dr. Eugene Pendergrass, University of Pennsylvania, Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. S. C. Davidson, Highland Hospital.
Meets monthly on the first Friday evening at 7.45 at the Rochester Medical Association Building.

ST. LOUIS ROENTGEN CLUB
Secretary-Treasurer, Dr. L. R. Sante, Metropolitan Building.
Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY
Secretary, Dr. Davis Spangler, Dallas, Texas.
Meets annually.

British Empire

BRITISH RÖNTGEN SOCIETY
Meets on the first Tuesday of each month from November to June inclusive, at 8.15 P.M., at the British Institute of Radiology, 32 Welbeck St., London; W. 1.

BRITISH INSTITUTE OF RADIOLOGY
Secretary, Dr. John Muir, 32 Welbeck St., London, W. 1.
Meets at 32 Welbeck St., but regular dates and times of meeting have not yet been arranged.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets on the third Friday of each month during the winter at 8.30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

RADIOLOGICAL SECTION, AUSTRALASIAN MEDICAL CONGRESS
Secretary, Dr. C. A. Anderson, The Hospital, Dunedin.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION
Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.
Meets monthly at Melbourne during the winter.

CANADIAN RADIOLOGICAL SOCIETY
Secretary, Dr. E. C. Brooks, Montreal.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch.
Meets annually.

* Secretaries of societies not here listed are requested to send the necessary information to the editor.

CONTINENTAL EUROPE

BELGIAN SOCIETY OF ROENTGENOLOGY
Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHOSLOVAKIA
Secretary, Dr. Walter Altschul, German University, Prague, II/52.

DEUTSCHE RÖNTGEN-GESELLSCHAFT (GESELLSCHAFT FÜR RÖNTGENKUNDE UND STRAHLENFORSCHUNG)
Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.
Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.
Next meeting with the Gesellschaft deutscher Naturforscher und Aerzte will be in Hamburg, September, 1928.

SUD- UND WESTDEUTSCHE RÖNTGENGESELLSCHAFT
Meets annually in different cities.

NORD- UND OSTDEUTSCHE RÖNTGENGESELLSCHAFT
Meets annually in different cities.
Next meeting September 27, 1928, in Hamburg.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA
Secretary, Professor M. Ponzio, University of Turin, Turin.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs S. A. Reinberg and S. G. Simonson.
Meets annually.
Fifth Annual Meeting in Kiev, Ukraine, May, 1928.

LENINGRAD ROENTGEN RAY SOCIETY
Secretaries, Drs. S. G. Simonson and G. A. Gusterin.
Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with the exception of the Denmark Society, meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN
Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY
Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK
Secretary, Dr. H. Scheuermann, Copenhagen
Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND
Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY
Secretary, Professor Holzknecht, Vienna, IX, General Hospital.
Meets on the first Tuesday of each month from October to July.

AMERICAN RADIUM SOCIETY

The Twelfth Annual Meeting of the American Radium Society opened at the Mayflower Hotel, Washington, D. C., on Monday, May 16, 1927, at nine o'clock, with the president, Dr. Albert Soiland in the chair. After reports were given of the various standing committees, the scientific program was taken up. Dr. Soiland spoke briefly on the importance of radium as a therapeutic agent and deplored the fact that an examination of medical journals published during the past year revealed a paucity of articles dealing with radium therapy. He called attention to the fact that the tendency in radium treatment is toward the use of relatively larger amounts of radium, with greater screening and greater distance.

Dr. James A. Corscaden of New York City, presented a paper on "Arthritis and the Radiotherapeutic Menopause." Since it has been reported in the literature that arthritis seems to be a common symptom after the establishment of artificial menopause and that this acts as a deterrent to the use of radium in benign uterine conditions, it seemed worth while to establish the truth or falsity of this statement. Dr. Corscaden reported on 60 cases divided into two groups: those over forty and those under forty years of age. Only 5 women in the group over forty years of age developed persistent symptoms referable to the extremities. None of the women under forty have had joint symptoms persisting subsequent to the radiotherapeutic menopause. These results thus disclose no constant arthritic symptoms following the establishment of the radiotherapeutic menopause. Two factors which seem to be of any importance are the possibility of a vasomotor disturbance and the possibility of some effect on the calcium metabolism. From a few experiments on dogs it appears that there may be some calcium change in the blood following castration; and there-

fore in advising or attempting radiotherapy for benign uterine conditions one must be guided by other considerations than the possibility of joint symptoms.

Dr. Leda J. Stacy of Rochester, Minn., spoke on "Complications following the Use of Radium in Gynecology." In treatment of malignant disease of the uterus with radium the immediate complications most frequently arising are pelvic infection, severe systemic reaction in cases with associated marked secondary anemia or in cases of extensive and infected lesion, irritation of the bladder and ureteral obstruction in cases of extensive infiltration of the broad ligament. The late complications in such cases consist in vesicovaginal and rectovaginal fistulae, chronic ulceration of the rectal mucosa and of the bladder mucosa. The immediate complications occurring in cases of uterine myoma or fibrous uterus treated with radium are the lighting up of a quiescent salpingitis or cellulitis and a marked systemic reaction. The late complications in this group may be hemorrhage at the first menstrual period following radium treatment, stenosis of the cervical canal with the development of pyometritis and the menopause syndrome. Dr. Stacy discussed the methods which are employed at the Mayo Clinic to obviate as far as possible these complications, and their treatment if they do occur.

Dr. O. L. Norsworthy of Houston, Texas, opened the discussion on these two papers. In discussing Dr. Stacy's paper he said that pelvic infection should and could be prevented in practically all cases of malignancy of the cervix. One of the most certain ways to prevent this is a carefully made diagnosis; another method in preventing infection is carefully carried out surgical aseptic technique. If pus is present an early localization and evacuation of the pus with treatment will do much toward controlling the symptoms.

Dr. William P. Healy of New York, discussing Dr. Stacy's paper, said that he believes that in advanced cases of pelvic inflammation it is wiser to ignore the carcinoma for the time being and to clear up the sepsis. In such cases he has not attempted treatment with radium after the inflammation is cleared up but has referred such a patient to the roentgen-ray department for treatment. Dr. H. J. Ullman of Santa Barbara, Calif., suggested the use of ultraviolet radiation of trophic ulcers of the bladder and rectum.

The meeting adjourned at eleven-thirty to attend the clinic by Dr. Douglas Quick which was given in the Section on Radiology of the American Medical Association.

The scientific session was resumed at two o'clock on Monday afternoon, the first paper being by Dr. William L. Brown of Chicago, on "Radium in the Treatment of Leucemia." In the treatment of this condition radium and roentgen rays offer the most useful therapeutic agents which we have today. In the cases reported (22 cases, 13 of the myelogenous type, 6 of the lymphatic type and 3 not classified) no ill effects from the treatment with radium have been observed. Dr. Brown reported one case in detail which has been under treatment since January 12, 1926. He has been able to reduce the white cell count from 675,000 and to keep it between 7,500 and 14,000. He has given sixteen applications of radium at about monthly intervals, each treatment being given before an acute excerbation of symptoms, this latter point being, he believes, a very important one in the treatment of leucemia. Frequent blood examinations must be made during the treatment and constant thorough medical attention is necessary to prevent intercurrent infections. Poor results are often due to the fact that the patient goes too long without treatment. Of the patients treated the benefit has been in direct proportion to the frequency of the applications.

Dr. H. H. Bowing of Rochester, Minn., in discussing this paper, agreed that palliation is all that can be expected in leucemia. At the Mayo Clinic they consider it satisfactory if the blood count is kept between 8,000 and 14,000 or even up to 20,000. They prefer to give the treatment in two, three or four applications, at intervals of five to seven days. At the conclusion of each treatment a blood examination is made. In the myelogenous type, radium treatment alone to the spleen and glands will not decrease the myelocytes; it is necessary also to give roentgen-ray treatment to the long bones.

Dr. Stone of Detroit called attention to the fact that in the treatment of leucemia, small doses of radium chloride intravenously seem to give a great deal of relief. If this is given in conjunction with irradiation with radium packs and deep roentgen-ray thrapy, the doses of these latter two agents may be much smaller.

Dr. M. J. Sittenfield of New York City presented a "Critique of the Biological Effects of Radium in Cancer." He believes it is now time to review what has been accomplished up to the present and formulate problems for the immediate future. One reason is that some writers report favorable results in the treatment of malignant disease while others report unfavorable results. A few of the factors which enter this complex problem are the intensity of the beam of radiation, the quality and quantity of the different wave lengths, the amount and character of the filtration, the duration of exposure, the area irradiated, whether superficial or deep, and the radiosensitivity of the component elements which make up the tumor. Dr. Sittenfield confined his remarks to this last phase of the question—that of radiosensitivity of the elements making up the new growth. He enumerated the types of cells which are supposed to be most radiosensitive. He concludes from the work of others that radiosensitiveness depends not so much upon the histological structure of the cell as it does upon its functional activity. However, from his own experiments the impression is gained that mitotic activity and increased metabolic activity do not in general explain the increased radiosensitiveness. In this connection it seems as if secondary radiation may play an important part; for instance, a tumor appears more radiosensitive after colloidal lead, which has a special affinity for embryonal cells, has been injected into the patient. However this whole question is one little understood and demands much study.

In discussing this paper Dr. H. J. Ullmann of Santa Barbara, Calif., questioned whether the sensitivity of leaded tumors is due to secondary radiation or to summation of injuries. If due to secondary radiation, the sensitivity should become manifest immediately after injection or very soon thereafter, for the lead remains in the blood only one or one and a half hours. As a matter of fact, the tumors show very little sensitivity just after the injection, but three or four weeks subsequent to the injection they become extremely sensitive. In the second place, the amount of lead injected is so small that it cannot even be visualized roentgenographically and therefore could not cause secondary radiation. Thirdly, the tumor cells do not contain lead out of proportion to other tissues; as a matter of fact, the liver takes up the largest amount.

Dr. Ira I. Kaplan of New York City reported on "Mouth and Face Conditions Treated by Radium Emanation at Bellevue Hospital, New York City." The method in use is based upon the method of the Curie Institute, Paris. Wax appliances are used to give distance. A biopsy is always done prior to treatment. Roentgenograms are always made and if they show too large an area of bone necrosis no treatment is given. Preliminary mouth hygiene and disinfection are considered important. Then irradiation by high voltage roentgen rays is given over adjacent lymphatic drainage areas, followed immediately by radium treatment of the local lesion—small doses over long periods of time being preferred. The prognosis in the type of case received at Bellevue is usually bad.

Dr. Lawrence A. Pomeroy of Cleveland, Ohio, next gave a paper on "Five Year Results of Radium Treatment in Carcinoma of the Cervix Uteri." In a series of 227 cases of carcinoma of the cervix treated by radium, 29 cases have been observed for five years or more. Of these, 5 or 17.2 per cent are apparently well. Tumors classified as adenocarcinoma of the cervix constitute over half of the apparently arrested cases. The present technique which combines implantation of seeds of emanation directly into the cervix with the application of screened tubes of radium element within the cervical canal was described in detail.

In discussing Dr. Pomeroy's paper, Dr. William P. Healy of the Memorial Hospital, New York City, gave an outline of the treatment used there and some of their results. He believes that the most important considerations are the clinical condi-

tion and the extent of the local lesion when the patient comes under observation, and the ability of the organism to maintain its defense reactions.

Dr. G. Failla, of the Memorial Hospital, New York City, described in detail and illustrated with lantern slides a new radium "pack" which he has designed and which contains 4 gm. of radium element. The lead housing for the radium weighs 500 pounds. Mechanical means provide for enough latitude of movement so that exact placing of the pack is possible. Data were given to show the distribution of radiation within the patient's body under typical conditions of treatment.

The first paper of the Tuesday morning session was given by Dr. G. Allen Robinson of New York City, his subject being "Radium Treatment in Tuberculous Adenitis." He reported a series of 25 cases treated with radium. Of these 18, or 72 per cent, are clinically well, 2 with advanced pulmonary tuberculosis are dead and 5 are improved but still have active nodes. His conclusion is that radium when properly used is a safe procedure and gives a high percentage of cures.

Dr. H. H. Bowing discussed this paper. It is his belief that conservatism is the keynote for the radiation therapist whether radium or roentgen rays are employed, for if the treatment is too vigorous the patient will be disfigured. His preference is for very light therapy rather than for heavy intensive treatment.

Dr. G. E. Pfahler of Philadelphia also emphasized the importance of not overtreating these cases. His experience has been limited more to treatment with roentgen rays than with radium. It is his rule never to exceed six or eight erythema doses, as the total, in any length of time, and he keeps as much under this limit as possible. Dr. Pancoast emphasized the importance of an absolutely certain diagnosis as one of the essential points in the successful treatment of tuberculous adenitis.

A report was given by Dr. A. Strauss of Cleveland on the "Radium Treatment of Cavernous Hemangioma and of Epulis." This report was based on 22 cases, of whom 11 were under six months of age. He believes it is important to get these cases as early as possible since the cosmetic results are much better. For hemangiomas the needles are used in the form of plaques. A number of slides were shown to demonstrate the results of treatment. The report on epulis covered 4 cases treated with radium. The needles are embedded directly into the growth, without taking a specimen. Good results have been obtained.

Dr. William H. Schmidt of Philadelphia then reported on "The Use of Buried Radium in Cavernous Angiomas Covered with Healthy Skin." This report included 3 cases. With buried radium it has been found possible by the method used to shorten the time of treatment from a year to about one month; usually only one treatment is given.

Dr. William Neill, Jr., of Baltimore, discussed Dr. Schmidt's paper. At the Howard A. Kelly Hospital the method of treatment differs somewhat from that of Dr. Schmidt's. They use a smaller dosage and treat entirely by gamma radiation. They rarely treat an angioma at intervals of less than one month and never use the buried radium technique. He believes one of the most important things in the treatment is to impress upon the mother the necessity of patience. He also believes that after the treatment is over it helps to have a little cold cream massaged into the skin. This brings back the normal texture of the skin and relieves any itching that may result.

Dr. Bowing discussed the papers of Dr. Strauss and Dr. Schmidt. He agrees with Dr. Strauss that it is important to treat the cases as early as possible. He favors surface radiation and believes there is always a chance of infection when buried radium is used.

The first paper on Tuesday afternoon was by Dr. H. K. Pancoast on "The Radiation Treatment of Brain Tumors." This report includes 136 cases and covers an experience of thirteen years in the treatment of brain tumors with radium and roentgen rays. The report dealt not so much with results as with methods of treatment, since at present it is desirable to determine what method of treatment the different types of brain tumors will respond to. Of the 136 tumors, 46 were of the

pituitary (not touched upon in this report), 42 were cerebral and 48 cerebellar. No good results were obtained with the cerebral tumors, with one or two exceptions. Of the 48 cases of cerebellar tumors, 25 were known to have lived from a few months to thirteen years. Since 1923, all cases have been treated by deep roentgen therapy alone, the dose being 100 per cent of a skin unit dose at the tumor site. Dr. Pancoast concludes that while radiation therapy offers a method of treatment, no more should be expected from the radiation treatment of brain tumors than of malignant growths in any other part of the body.

Dr. Burnam of Baltimore in his discussion reported an experience with 36 cases of brain tumor. Except in a few cases, they have given something under the 100 per cent skin unit dose.

Dr. H. H. Bowing of Rochester, Minn., gave a report on "Malignant Tumors of the Thyroid Treated by Surgery, Radium and Roentgen Ray." One hundred and sixty seven cases have been treated at the Mayo Clinic. Adenocarcinoma is the common type of malignant growth found in the thyroid. The treatment of choice for these malignant growths is a combination of roentgen and radium therapy. Of the cases treated, 40 patients of the inoperable group were improved and 6 were not improved.

Dr. R. E. Loucks of Detroit, Mich., read a paper on "Clinical Evidence of Thyrotoxic Control after Radium Therapy." From his observations he concludes that the control of symptoms, reduction in size of gland, increase in body weight and a normal metabolism are sufficient evidence to convince the most skeptical of the value of radium therapy in this condition.

RUTH BIGELOW.

SECTION ON RADIOLOGY

AMERICAN MEDICAL ASSOCIATION

WASHINGTON, D. C., MAY 18–20, 1927

The opening session of the Section on Radiology of the American Medical Association was held at 2 P.M. on Wednesday, May 18, 1927, the chairman, Dr. Albert Soiland presiding. In his address Dr. Soiland outlined in a general way the place and possibilities of roentgenology and radium therapy. This was followed by a paper on "Unusual Bone Changes Caused by a Small Primary Bronchiogenic Carcinoma" by Dr. H. B. Thomas, Dr. E. W. Hirsch and Dr. E. S. Blaine of Chicago, presented by Dr. Blaine. A case was reported in which the diagnosis of the bone changes proved baffling from all angles of study. At post mortem a very small carcinoma was found in a bronchiole which proved to be the primary lesion.

Dr. Frederick H. Rodenbaugh of San Francisco presented a joint paper with Dr. Irving S. Ingber on "Diverticula of the Small Intestine: Incidence and Symptomatology, with Illustrative Case Histories." He stated that these diverticula are probably congenital in origin and may be present during life without causing any symptoms. When symptoms do occur they are apt to be indefinite and confusing. A definite diagnosis can be made only by roentgen examination and in this, serial films are essential.

Dr. Lewis Gregory Cole of New York discussed this paper. It is his belief that one should be cautious in making a diagnosis of diverticulum, and especially in ascribing the patient's symptoms to such a diverticulum. It has been his experience that surgery does not relieve the symptoms in a great majority of the cases of the common type. He would advise the roentgenologist to use great care in reporting these diverticula and should a diagnosis of diverticulum be made, to try to persuade the surgeon not to resort to surgery.

Dr. A. B. Moore of Rochester, Minn., gave a report on "Benign Tumors of the Stomach from the Roentgenologic Point of View." His report covered 41 cases of benign tumor of the stomach observed at the Mayo Clinic and which came to operation. As compared with malignant new-growths, benign neoplasms of the stomach are rare. The report covered the points of differentiation of benign tumors from malignant new-growths and other gastric lesions. It is concluded that the most efficient aid in the diagnosis is the roentgen ray and that since the points of differentiation are now much better understood,

diagnosis of these lesions will be made more accurately than in the past.

Dr. George W. Holmes of Boston opened the discussion on this paper. From 1912 to 1925 he has had 7 proven cases of benign lesions of the stomach. He stressed as important the differential diagnosis of benign lesions from malignant inoperable neoplasms. Dr. H. K. Pancoast believes that all benign gastric tumors should be operated on since they are potentially malignant.

The next paper was by Dr. M. J. Hubeny of Chicago, on "Pain; its Value; its Elusiveness." Pain is common to many pathological conditions not always easy to differentiate. However, with modern methods of diagnosis, pain which is a purely subjective phenomenon, can almost be classed as an objective symptom. The experience of the roentgenologist shows that the severity, persistence or total absence of pain is occasionally at variance with the magnitude of the disease. Roentgenographic diagnosis often assists in explaining the cause of pain because it reduces the intangible to the tangible.

A paper by Drs. F. E. Simpson and R. E. Flesher of Chicago on "Radium in the Treatment of Vascular Nevi" was given by Dr. Flesher. He reviewed the methods that have been used in the treatment of these nevi and concludes that radium offers the best results of any known agent. He presented the advantages and disadvantages of radium treatment and stated that the disadvantages might be avoided altogether by use of a proper technique. He showed slides of a number of cases illustrating the excellent results which were obtained from radium treatment of vascular nevi.

In discussing this paper Dr. G. W. Grier of Pittsburgh agreed that radium treatment is the treatment of choice, no good results having been obtained by use of roentgen rays. He emphasized the need for treatment over a long period of time.

Dr. George M. MacKee of New York gave a very adequate "Summary of Roentgen-Ray Therapy in Dermatology," covering the different types of transformers used, instruments used in measuring dosage, etc. He threw on the screen a list of about 90 skin diseases more or less amenable to roentgen treatment, his conclusion being that the roentgen ray is the most important single remedy in dermatology. However, this remedy must not be abused, and it must not supplant a knowledge and use of dermatologic materia medica and therapeutics.

This concluded the Wednesday afternoon session.

The program was taken up again at two o'clock on Thursday afternoon. The first paper of the afternoon was by Dr. Francis Carter Wood of New York on an "Experimental Investigation of the Therapeutic Value of a Combination of Colloidal Lead and Roentgen Rays in the Treatment of Cancer." Since Blair Bell had apparently shown that a combination of roentgen rays and lead was somewhat more effective than lead used alone, it seemed necessary to investigate this important fact by elaborate tests on animal tumors. Dr. Wood outlined some of the experiments which they have carried out and the results obtained. In some of the experiments where lead was used the amount of roentgen rays needed to kill the tumor was reduced (in one particular experiment with a tumor requiring 4 erythema doses to kill, after lead was used 3 erythema doses killed the tumor). Although the results have been rather disappointing so far, it seems worth while to carry on the experimental work and also to work along the lines of finding a less toxic substance than colloidal lead.

The discussion on this paper was opened by Dr. J. Shelton Horsley of Richmond. He stated that his experience with the use of the lead treatment has not been particularly encouraging. He has had no experience with use of lead in experimental animals, but he has employed it in three or four cases of inoperable carcinoma, following the lead injection with intensive roentgen-ray treatment. His conclusions from these few cases are that the results are not favorable. The patients are made very ill by the treatment, and life is not prolonged. Dr. Horsley has abandoned the treatment for the time being.

The next paper was by Dr. H. J. Ullmann of Santa Barbara, Calif., on the "Combination of Colloidal Lead and Radiation in

Cancer Therapy." He stated that while colloidal lead may exert a destructive effect on malignant tumors it is so toxic that its use is extremely dangerous. He has been seeking a less toxic substance, and has been experimenting with a lead phosphate preparation. He believes that there is sufficient evidence to warrant the further development of this method of treatment.

The discussion on Dr. Ullmann's paper was opened by Dr. O. N. Meland of Los Angeles. He has treated 18 cases with the preparation obtained from Dr. Ullmann. There seems to be no question about the effect of lead upon the tumor but it has an unfavorable effect upon the organism as well.

It seemed to be the consensus of opinion of those who have used colloidal lead that the present preparation is very unsatisfactory and that work should now be directed toward the production of less toxic preparations.

Dr. Douglas Quick, New York City, presented a paper on "Radium in Massive Dosages in the Therapy of Cancer." In the few years that radium has been extensively used it has been subjected to severe criticism. The fact to be emphasized is that an adequate dosage is necessary if satisfactory treatment is to be obtained and that an inadequate dosage is responsible for failures. He believes that although both quantitatively and qualitatively radium is superior to the shortest wave length of roentgen rays, unless an adequate dose of radium is used, a good roentgen-ray dose is more effective.

Dr. B. P. Widmann of Philadelphia presented a joint paper with Dr. G. E. Pfahler on "The Value of Glucose Injections during Radiation Treatment of Malignant Disease." This report covered an experience with 111 cases in which a freshly prepared dextrose solution, 33 per cent, was used, followed by irradiation. Six of the cases were not malignant and 105 were malignant. The conclusions from the observations in these 111 cases are that there is no evidence to indicate that dextrose injections combined with radiation therapy improve the end results over radiation therapy alone.

Dr. Howard P. Doub, Detroit, in his discussion of the above paper stated that he is in agreement with these conclusions. He expressed his appreciation of the paper given, stating that in his opinion such papers giving negative results are as valuable as reports of positive findings.

Dr. U. V. Portmann of Cleveland presented a paper on "Radiation Therapy in the Treatment of Carcinoma of the Thyroid Gland." This report was based on 166 cases of malignant disease of the thyroid gland in which the diagnosis was unquestioned. His conclusions are that there is a very definite advantage in combining operation with irradiation in malignant disease of the thyroid.

Dr. H. H. Bowing of Rochester, Minn., discussed this paper. It is his belief that with surgery, roentgen and radium therapy one has a definite procedure to offer patients with carcinoma of the thyroid.

The last paper of the Thursday afternoon session was by Dr. Arthur Erskine of Cedar Rapids, Iowa, on "The Management of Cancer of the Breast." The data on which the paper was based seemed to justify the following conclusions: The possibility of cure of breast cancer depends almost entirely on the stage at which the operation is done; more to be expected from measures tending to advance the time of operation than from increased surgical skill, more radical operations, or better roentgen therapy. Radical dissection of the axilla is unnecessary when the disease is confined to the breast, and it is futile in all cases of supraclavicular metastases and almost all cases of axillary metastases. Routine radical dissection of the axilla should be discontinued. Roentgen-ray therapy is prophylactic and palliative. Pre-operative roentgen-ray therapy should not be permitted to delay operation in early cases. Postoperative roentgen therapy should be given as a routine measure.

The first paper of the concluding session of the section on Friday afternoon was by Dr. A. S. Warthin and Dr. E. A. Pohle of Ann Arbor on "The Effect of Roentgen Rays on the Heart," presented by Dr. Pohle. Since a review of the literature revealed the fact that little is known concerning the effect of roentgen rays on the heart it seemed important to conduct animal

experiments along this line. The clinical importance of such an investigation is evident since deep roentgen therapy is used in many diseases of the chest in which the radiation has to pass through the heart. The authors found that a single exposure to a known quantity and quality of radiation, measured in R units and therefore reproducible, corresponding to an average adult erythema dose, does not produce any injury, demonstrable histologically, to the hearts of rabbits and rats.

Dr. P. M. Hickey of Ann Arbor presented a timely paper on "Standards in Roentgenology." His conclusions are that it is desirable (*a*) that there be more uniformity in the teaching of roentgenology to undergraduate students; (*b*) that roentgenologists make a determined effort to require a higher standard of qualifications in those practicing this specialty; (*c*) that more uniform types of roentgen reports be established in clinics and hospitals, and (*d*) that a standard nomenclature be adopted for the purpose of clarifying the literature.

A paper was next given by Dr. F. S. Bissell of Minneapolis on "The Metamorphosis of Tuberculous Lung Changes as Observed in Serial Roentgenograms." His conclusions are that serial roentgenographic examinations covering periods of months or even years, when interpreted in the light of known disease, may serve to broaden the conception of various phases of this disease.

Dr. V. V. Norton, Cincinnati, gave a report on "Basal Tuberculous Lesions." He stated that roentgen-ray densities of basal tuberculous lesions may easily simulate densities due to other etiologic factors such, for example, as the densities of caseous bronchopneumonia, and the roentgenologic diagnosis should therefore never be final.

The next paper was by Drs. Samuel Brown and H. B. Weiss of Cincinnati on "Lateral Views of the Thorax." Realizing that plain front views and stereoscopic views of the chest may not reveal all the conditions within the thorax, lateral views were developed in an effort to further localize lesions within the thorax. Iodized oil in association with lateral views of the chest is of great aid in diagnosis.

Dr. William H. Schmidt, Philadelphia, presented a paper on "Cancer of the Tongue." The results from radium and roentgen therapy have not been very satisfactory. In the operable class of cases surgery is the most satisfactory form of treatment. In the inoperable cases the electrothermic method of treatment has opened a large field.

The final paper on the program was by Dr. Isaac Levin of New York, on "Intraperitoneal Insertion of Capillary Tubes of Radon in Cancer of the Abdomen and Pelvic Cavities." He described the technique of intraperitoneal insertion of capillaries of radium emanation and stated that this method of intratumoral insertion of radium does not increase the hazard of laparotomy. He gave the types of cases in which this method of radiotherapy is indicated.

The officers elected in the Section for the coming year were: Chairman, E. H. Skinner, Kansas City, Mo; Vice Chairman, Charles Waters, Baltimore; Secretary, Fred M. Hodges, Richmond, Va.

RUTH BIGELOW.

UNCOATED CAPSULES IN CHOLECYSTOGRAPHY

To the Editor:

So much emphasis both by roentgenologists and by chemical houses has been laid upon the necessity and importance of a suitable enteric coating for the successful application of the Graham test when administered orally, that I thought it might be of interest to report my experience with this test.

Inadvertently at first and then with deliberate intent, I have examined ten cases of suspected gall-bladder disease with Mallinckrodt's Iodeikon ampoules, exhibiting the fresh powder in plain gelatin coated capsules which have had no other coating, all of which were presumably dissolved in the stomach; at least there were no capsules undissolved at the examination. They were given in doses of three capsules at a time, repeated every fifteen minutes, the entire dose being taken within an hour. With each dose there was given a quarter of a teaspoonful of bicarbonate of soda in a quarter of a glass of water. The usual pro-

cedure was followed of partaking of a rather fatty meal at supper time and the capsules begun two hours later.

In no case was there any gastric or intestinal disturbance reported or complained of, and particular effort was made to bring out any such reaction by careful questioning. The shadows obtained in the normal cases compared favorably with the shadows obtained after taking capsules having an enteric coating. I think it is quite possible that the exhibition of the alkaline salt with each dose may have helped to obviate the gastric irritation by tending to neutralize the gastric acidity.

This communication is not intended as an argument against the use of enteric coated capsules, nor to favor the use of plain gelatin coated ones, but simply to call attention to the apparently exaggerated emphasis laid upon the necessity of preventing the dye from coming in contact with the gastric mucosa.

L. F. WHEATLEY.
New Haven, Conn.

ADDRESS BY DR. P. M. HICKEY

UPON PRESENTATION OF MEDAL TO DR. WM. D. COOLIDGE BY THE AMERICAN COLLEGE OF RADIOLOGY

In turning over the annals of medieval chemistry, we always love to linger over the recital of the lives of the alchemists, who pursued that *ignis fatuus*, the transmutation of metals. Dreaming to change some base metal into gold; dreaming to find some cure for all diseases. Too often, their hope was riches; each striving for his own personal emolument. Their experiments were often disappointing but their fertile minds were ever impelling them to try some new combination, or to treat some old combination in a new and different manner. So one by one the lives of these old alchemists came into prominence and died away as the decades rolled along. The historians of the middle ages have drawn many picturesque sketches of those old-time laboratories, furnished usually with the most meager equipment, where the patient experimenter toiled often far into the night.

But now in our own time we find that the dream of the alchemists has come true. One of our own generation had the vision that a metal more useful than gold could be found. He dreamed of producing something which would replace the fragile carbon filament. He dreamed of finding a metal so ductile that it could be spun to the fineness of a microscopic hair; a metal so suitable for harnessing securely the incredibly swiftly flying electrons that the way would be opened for lighting the most remote places of the world. The chemists knew of the existence of tungsten; they knew its high melting point, but how to change that impalpable gray powder into a metal that would be serviceable for man? That was the problem. One of our own generation found that with hammer and heat he could eclipse the dreams of the alchemists of old, transmuting that subtle gray powder into the untold miles of fine glowing wire which today light the whole world. Some of us remember the old Brush arc-light with its dazzling, fizzling flickers, and the fragile carbon filament; further back we remember the inconveniences of the oil lamp, and the flickering gas flame; all these have in your and my time been transmuted into tungsten which has turned night into day. As I say these words I know that in your minds are pictures of the tiny, almost microscopic, bulbs which light up the before hidden body cavities, contrasted with the giant bulbs with their dazzling brilliancy.

In the first decade of this century, I remember visiting what was then a famous *x*-ray laboratory, located in one of our western cities. On the walls hung a hundred tubes, each found to be useful for some particular need in diagnosis. If that same laboratory were in existence now we would find that the hundred or more tubes would be replaced by possibly two or three. The old art of juggling the gas tube has been almost lost, for we have now an instrument of precision, fashioned to produce as many notes as a violin, quick to serve its master, ready to be tuned for every diagnostic need. The same genius who turned that dull gray powder into a precious metal solved most of our troubles both in diagnosis and treatment. This genius has made our laboratory tasks so easy that we find it

hard to realize how great is the debt of humanity to him. In the old days of the gas tube with all its eccentricities, the applications of the *x*-ray art were few. Now, with our splendid modern tubes the field of *x*-ray diagnosis and therapy has been so broadened that pain and suffering have been relieved and often banished.

In the olden days in Greece, rich in art, literature and statesmanship, the citizens of that famous country held those annual games of which the matchless Pindar has so beautifully sung in immortal words framed in faultless meter. At the close of those annual games the victor received the laurel crown so highly prized. And so down through all the ages—to the victor belongs the laurel crown whether it be in the physical games of life or in those intellectual strifes where superiority of intellect and painstaking perseverance have caused their owner to outstrip his fellows in the modern race of science. In the games of old the laurel crown was a symbol of man's appreciation of physical endurance and achievement. This evening we gather here, a small society selected from the ranks of the great roentgenologic profession, to express our appreciation of the achievements of one who has done so much for the good of man. We are met here, conscious that we represent a great army of grateful roentgenologists, to hand to you, Dr. Coolidge, a token which is a visible sign of the appreciation of the way the roentgenologic world values what you have done. Therefore, as President of the American College of Radiology, it is my very great pleasure to present you with this medal from the American College of Radiology, symbolic of the radiologic world, a visible token of the appreciation of the work which you have so modestly and so unselfishly wrought for humanity. We hope that as you may look on this symbol from time to time, your magic power of transmutation may cause this little circle of gold to be transmuted into the laurel wreath of gratitude and respect which so many entertain for you. I cannot forebear to quote from Pindar, "For the thing that one hath well-done, goeth forth with a voice unto everlasting. Over fruitful earth and beyond the sea, hath the light of fair deeds shined, unquenchable forever."

REPLY BY DR. COOLIDGE

Mr. President and Members of the American College of Radiology: Allow me to express to you my deep appreciation of the honor which you do me in presenting to me this beautiful medal with all that it signifies.

The work to which Dr. Hickey has referred was not done single handed, but was carried out with the help of a large number of able and loyal assistants, who are entitled to much of the credit, and with the encouragement of Dr. Whitney and others without whose support the work could not have been done.

Furthermore, a large part of any success which we have had in the *x*-ray field, has been due to your close co-operation with us, for it is largely through this co-operation that we have been able to learn the needs of the art.

This medal will always remind me of the delightful personal relations which I have enjoyed with so many of you and will speak to me of your friendship and of your regard.

SECOND INTERNATIONAL CONGRESS OF RADIOLOGY

To the Editor:

The 1st International Congress of Radiology in London, 1925. decided that the 2nd International Congress should be held in Stockholm, 1928 with Professor Gösta Forssell as President. The Swedish Committee for organising the Congress has fixed the time for same to July 23rd–27th 1928.

You would greatly oblige us by *publishing the enclosed communication concerning the Congress in the next number of your journal* on a full page strikingly placed and inserted in such a manner that the under part of it may be used as subscription form.

We hope you will further the interest that all friends of Radiology have for the Congress, by publishing this communication. We expect a great number of your readers to attend the Congress and we shall do our utmost that the members may benefit as much as possible by the same. We would greatly appreciate being notified in what number of your paper the communication will be published. You would

further oblige us by *inserting in the text of your journal a notice* on the 2nd International Congress of Radiology referring to our communication.

We should greatly appreciate if you will take an interest in our work when organising the Congress and await with pleasure your suggestions for furthering the success of the Congress.

We are, dear Sir,

Yours sincerely,
GÖSTA FORSSELL.
President.

CANADIAN TOURS

Those planning to tour in Canada should apply to the Montreal Tourist and Convention Bureau, Phillips Square, Montreal, from whom up-to-date information concerning routes to Montreal, conditions of roads, etc., can be obtained without charge. This information can be obtained by writing to the Bureau, calling personally at the Bureau office or by telephone after arrival in the city. To those wishing to tour extensively in the Province the Bureau will be pleased to send free a large road map of the Province of Quebec and a guide book in French and English of 154 pages with illustrations, maps, traffic regulations, lists of country hotels, hunting calendar, etc. With this information plans can be made beforehand for tours of from one to thirty days.

AMERICAN ROENTGEN RAY SOCIETY

The Twenty-eighth Annual Meeting of the American Roentgen Ray Society will be held in Montreal at the Mount Royal Hotel on September 20, 21, 22 and 23, 1927, and also at the Physics Building, McGill University, on September 22.

PRELIMINARY PROGRAM

Further observations on the saturation method as applied to the treatment of deep-seated malignant disease. G. E. Pfahler, M.D. Philadelphia.

The sensitiveness of the suprarenal gland to radiation, a critical analysis of the experimental and clinical evidence. A. W. Desjardins, M.D. Rochester, Minn.

Progress in treatment of giant celled sarcoma of bone. R. E. Herendeen, M.D. New York City.

Osteochondritis dissecans. Gordon E. Richards, M.D. Toronto, Ont.

Mediastinum roentgenologically considered. Webster W. Belden, M.D. New York City.

Peristaltic action of the fallopian tubes. I. C. Rubin, M.D. New York City.

Cholecystographic studies of the gall-bladder, after the administration of some of the popular cholegogues. William H. Stewart, M.D., and Eric J. Ryan, M.D.

Massive atelectatic collapse of the lung. Le Roy Sante, M.D. Webster Groves, Missouri.

Primary carcinoma of the bronchus. B. R. Kirklin, M.D. Rochester, Minn.

Experimental cinematography of the fluorescent screen. Russel Reynolds, M.D. London, England.

Examination of the esophagus. P. M. Hickey, M.D. Detroit, Mich.

Difficulties and how to overcome them in roentgen-ray treatment of skin diseases. George Miller MacKee, M.D. New York City.

The result of radiotherapy in cases of definitely proven carcinoma of the lungs. Maurice Lenz, M.D., and Leopold Jaches, M.D. New York City.

Giant cell tumor of the spine with report of a case. Albertus Cotton, M.D. Baltimore, Md.

Some observations on the use of antispasmodics in the roentgenologic examination of the gastro-intestinal tract. George W. Holmes, M.D., and Richard Dresser, M.D. Boston, Mass.

The roentgen-ray diagnosis of infantile scurvy. Ralph S. Bromer, M.D. Philadelphia.

Failure of cholecystographic filling in the presence of pylorie pathology. Edward H. Skinner, M.D. Kansas City, Missouri.

Paget's disease of the osseous system. L. T. LeWald, M.D. New York City.

Colon studies. v. The high cecum. John L. Kantor, M.D., and Samuel Scheeter, M.D. New York City.

Roentgen-ray diagnosis of tumors of the kidney pelvis. Report of a case. A. L. Gray, M.D., J. L. Tabs, M.D., and A. I. Dodson, M.D. Richmond, Virginia.

Toxic goiter, its diagnosis and treatment; especially roentgen and radium treatment. J. Thompson Stevens, M.D. Montclair, New Jersey.

Effects of radiation on bone with review of the literature and report of cases. T. A. Groover, M.D., A. C. Christie, M.D., and E. A. Merritt, M.D., Washington, D. C.

The biological study of the transmission of various types of screens in the ultraviolet region. Ernst A. Pohle, M.D. Ann Arbor, Mich.

Cathode rays. W. D. Coolidge, PH.D. Schenectady, N. Y.

Roentgenologic findings in eighty-seven cases of gastric syphilis. Alexander B. Moore, M.D., and J. R. Aurelius, M.D. Rochester, Minn.

Cinematograph of small intestine. Lewis Gregory Cole, M.D. New York City.

Roentgen therapy of gliomas of the brain. Percival Bailey, M.D., Merrill C. Sosman, M.D., and Arthur Van Dessell, M.D.

The treatment of hyperthyroidism, a consideration of the methods now in use. Edward Rose, M.D. Philadelphia.

Papers are also promised by Drs. Case, Imboden and Crane.

Demonstrations will be given for an hour in six laboratories and lecture rooms in the physics building of McGill University on September 22, illustrating the physics of roentgen rays and modern developments. This is by invitation of Professor Eve in coöperation with Asso-

ciate Professors Shaw, Keys, Bider and Reilly of McGill University.

The Banquet will take place on the evening of September 22, 1927, at the Mount Royal Hotel. The guest of honor will be Dr. W. D. Coolidge.

The Caldwell Lecture will be on the evening of September 21, 1927.

The lantern slide evening and cinematograph by Dr. Cole will be on September 20.

The Scientific Exhibit and Manufacturer's Exhibit will be held next door to the lecture room.

A golf tournament will be held and entertainments for the ladies will be arranged.

Members should make reservations early. Mount Royal Hotel, Windsor Hotel and Ritz Carlton Hotel are close together.

Subscribers to THE AMERICAN JOURNAL OF ROENTGENOLOGY & RADIUM THERAPY *visiting New York City are invited to make the office of the publishers (Paul B. Hoeber, Inc., 76 Fifth Avenue, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

DEPARTMENT OF TECHNIQUE

Department Editor: DAVID R. BOWEN, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

MOBILE VENTRICULOGRAPHIC APPARATUS

BY H. B. MCEUEN, M.D.

JACKSONVILLE, FLORIDA

THIS apparatus was designed to be used in the operating-room, making ventriculograms without moving the patient from the operating-room table. Figure 1 is a three-quarter photograph from the control side of the apparatus, showing the five-thirty control unit and transformer, also the synchronous time switch button which controls the travel of the Potter-Bucky diaphragm and exposure time for the roentgen machine. Figure 2 is a three-quarter photograph from the end of the machine which is placed at the head of the operating table and shows tube mounting, which is fixed, centering directly under the 11 × 14″ diaphragm mounted under the top of the apparatus, upside down, as is clearly shown by the webbing for fixing the head in position against it. The tube mount is provided for stereoscopic shifts in either direction across the diaphragm, and the distance of tube from diaphragm is fixed at the standard distance of 25 inches, as it was decided it would be easier to manipulate the operating room table for the correct height than it would be to have this distance changeable.

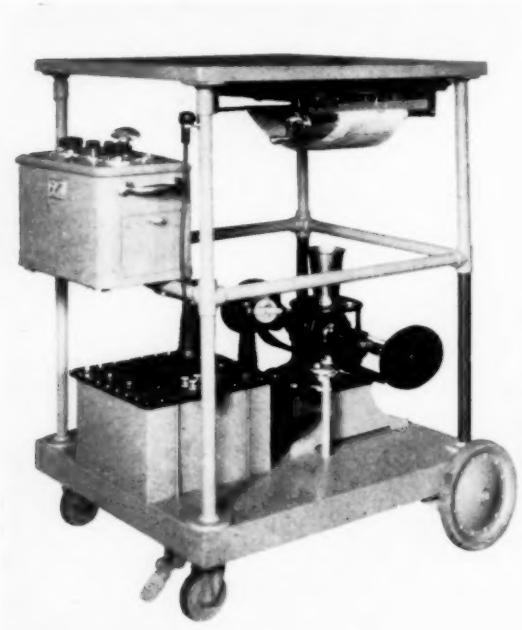

FIG. 1. Ventriculographic table, control side.

FIG. 2. Ventriculographic table, operating table side.

Primarily the apparatus was designed to reverse the usual position of the tube and film in relation to the patient's skull in the air injection studies of the ventricles of the brain. Having accomplished this, we are able to get the uppermost ventricle, in the lateral exposure, which is the air-filled one, at least one inch closer to the film than by the older technique, and in

the roentgenogram for the anterior horns we lessen the distance at least 4 inches, which also holds true for the posterior horns in the anteroposterior roentgenogram. This reduction of distances provides us with roentgenograms that have less distortion of the ventricular shadows and consequently are of greater diagnostic value. Figure 3 is a posteroanterior ventriculogram made with the apparatus, showing the anterior horns of the lateral ventricles and here will be noted the clean cut outlines and definition which are lacking in those made by the older method. In this position for the anterior horns the head is placed as if making a frontal sinus exposure; that is, the frontal bone is placed against the Potter-Bucky diaphragm, the patient lying on his back on the operating-room table with the occiput resting in the webbing of the diaphragm. Great care must be exercised in aligning the median line of the skull with the central ray from the tube, as any rotation of the skull from a true posteroanterior position may cause an erroneous interpretation of the resulting roentgenogram. While it is not considered a necessity, I think it advisable to make these in stereo, and the shift of the tube in this case should be along the median line, which also holds true for the posterior horns, which are obtained in the anteroposterior roentgenograms. Figure 4 is the lateral ventriculogram and shows more of the ventricular system of the brain than any other ventriculogram I have yet seen, and here again will be noted the sharpness of definition obtained in the ventricular shadow. These ventriculograms are also made in stereo, using a shift across the ventricle instead of the customary anteroposterior shift. It is advisable to proceed as follows: Either lateral should be the first exposure, this determined by which ventricle has been tapped and filled with air, as it is desirable to make this one first on account of its being uppermost and containing the entire quantity of air. The posteroanterior is next, then the opposite lateral and lastly the anteroposterior as with this procedure there will be less likelihood of the air escaping into the subarachnoid space. It is also advisable to rock the head back and forth several times in changing from one position to another to facilitate change of position of the air within the ventricles.

Advantages of the apparatus are: Ventriculograms of greater diagnostic value are obtained. There is less likelihood of contamination of the operative wound. The older method of transferring the patient from the operating room to the roentgen room necessitated a number of changes from tables to carriages, all of

Fig. 3. Posteroanterior ventriculogram.

which was repeated in taking the patient back to operating room for withdrawal of the air. With this apparatus the patient is not moved from the operating room table, his head only is projected into the apparatus at the end of the operating room table and the complete series of films are made. I have suggested that appliances such as the Granger mask be included in the equipment, including one mask for the lateral with a circular opening through which the ear may protrude, which will

allow its use in making the anteroposterior roentgenogram for the posterior horns. These masks will facilitate centering the skull in the desired position.

FIG. 4. Lateral ventriculogram.

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A COMBINATION TABLE FOR BRONCHOSCOPIC REMOVAL OF OPAQUE FOREIGN BODIES AND FOR REDUCING FRACTURES WITH ROENTGENOSCOPIC GUIDANCE

BY EUGENE P. PENDERGRASS, M.D.

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PHILADELPHIA, PENNSYLVANIA

A COMBINATION table allowing the successful removal of foreign bodies and adequate reduction of fractures is a necessity in large clinics where such procedures are indicated. During the last four years, we have had occasion to develop and use such a table. This table, as illustrated, meets all of the requirements for roentgenoscopic removal of foreign bodies and reduction of fractures and epiphyseal separations. It allows one to direct the bronchoscopic forceps into various portions of the lung and thereby guide the bronchoscopist to a foreign body that is beyond the limits of the bronchoscope itself. It is also an aid in the bronchoscopic instillation of lipiodol into a given portion of the lung, in which it is desired to demonstrate bronchial and parenchymal pathology.

A table for bronchoscopic use should have the following specifications:

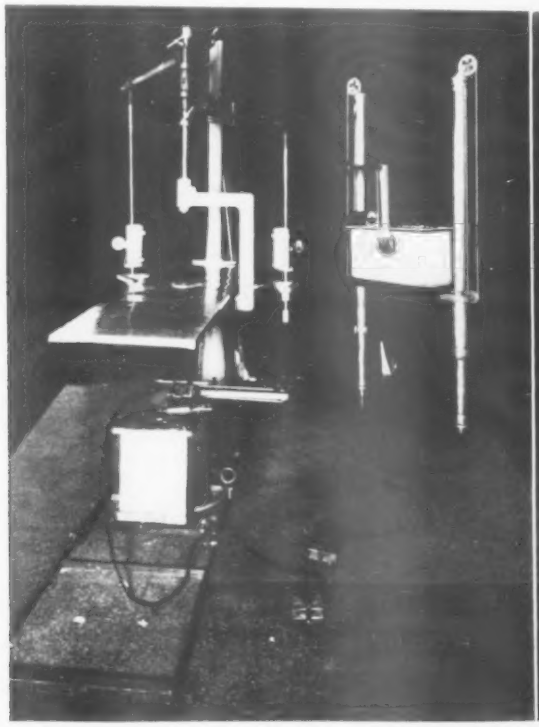

FIG. 1. The roentgenoscopic table properly set for the roentgenoscopic removal of foreign bodies. There are two roentgen-ray units so placed that they project the rays at right angles to each other.

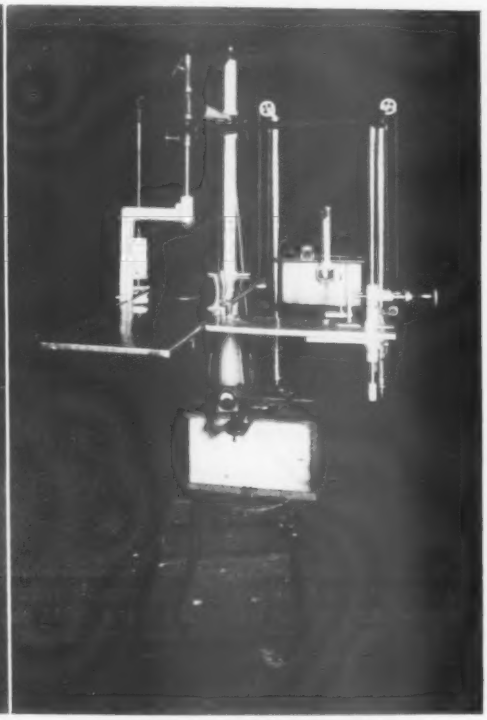

FIG. 2. The table is adjusted for the reduction of a fracture in the upper extremity. Note that the carrier for the vertical roentgenoscopic unit allows both rotary and side to side movements. The two clamps on the side of the table allow traction to be made without causing the patient to be pulled off the table.

1. The roentgenoscopic table should contain no opaque nails or fixtures which might confuse the roentgenologist and bronchoscopist in their attempt to remove an opaque foreign body from the lung.

2. The table must be substantial in order that there be no unnecessary vibration.

3. It must be safe.

4. Two oil immersed roentgen units should be arranged so as to project the rays at right angles to each other.

5. The units must be easy to move from time to time, and fixed in given positions. The units should have up and down, cross and rotary movements in order that the operator will not at any time be in the way of the bronchoscopic surgeon. To do this, it is necessary to have a track for the unit to travel upon. Otherwise, it is impossible to diaphragm down easily and successfully in order to give accurate information about a given foreign body.

6. Two roentgenoscopes are necessary, the edges being placed at right angles to each other.

In selecting a table for the reduction of fractures with the aid of the roentgenoscope, there are several features that must be considered.

1. The table must be adaptable to any fracture.

2. It must be easy to adjust.

3. One must have two oil immersed roentgen units arranged in such a manner as to enable one to obtain the rays from two directions, preferably at right angles to each other. This gives the surgeon an opportunity to reduce the fracture without the necessity of rotating the injured member.

4. Such a table must have apparatus to give extension, flexion and fixation.

5. It must be easy to keep clean.

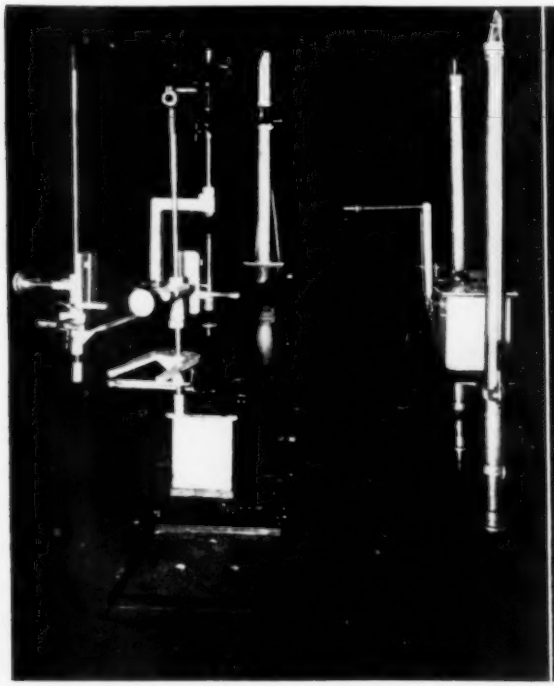

Fig. 3. Table adjusted for the roentgenoscopic reduction of a fracture of the bones of the leg. Note the perineal pin and the extension screws which allow traction and countertraction.

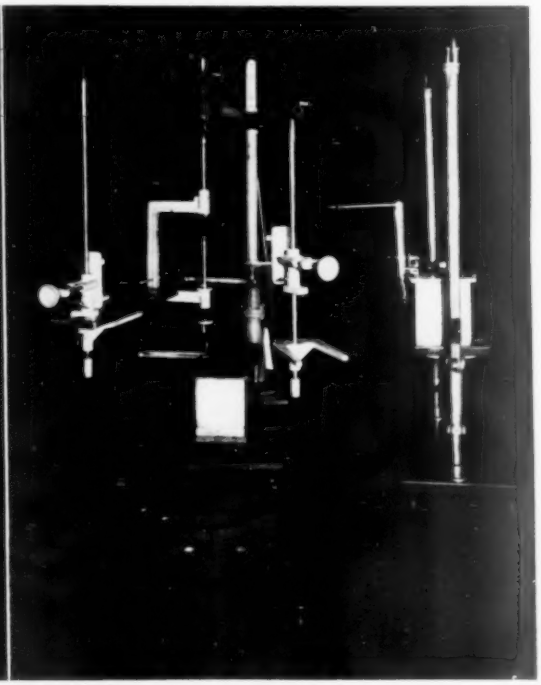

Fig. 4. The table is adjusted for a roentgenoscopic reduction of the femur. If a cast is to be applied, it can be applied here and the patient can remain on the table until the cast hardens.

6. All roentgen-ray equipment must be safe for the patient, surgeon, roentgenologist and assistant. This of course, precludes exposed wires, as the reduction is performed in a dark room.

In using the roentgenoscope, the tendency is to overexpose the patient and the surgeon. It is a rule in our laboratory that the intermittent control shall always be used in examining any patient by the roentgenoscope. That is, the roentgenoscope is used for a few seconds and then turned off for a second, thereby lessening the tendency to overexposure.

In reducing a given fracture, the location and type of injury are first determined by the roentgenoscope. Then the surgeon reduces, or attempts to reduce, the fracture in the usual way. If unsuccessful, the roentgenoscope is used to aid in visual reduction. If reduction and maintenance of reduction are successful, the appropriate dressings are applied at once.

The use of the roentgenoscopic table should not at any time prevent the making of the usual roentgen films for records and more exact interpretation. Our recommendation is that every patient should have at least three roentgen films: (*a*) directly after the accident, or as soon as possible; (*b*) after roentgenoscopic reduction, and (*c*) after final removal of the dressings. The films then act as a permanent record of the case and also afford a good record should there be any legal proceedings.

The advantages of a roentgenoscopic table for the reduction of fractures are many, some of which are as follows.

1. The number of open reductions is lessened.

2. The number of times ether or local anesthesia is administered is decreased.

3. The economic advantage is of importance to the patient, surgeon, roentgenologist and hospital, because the fracture usually requires only one reduction, thereby taking less time, and the convalescence is shorter and the hospital, therefore, has a quicker turnover of patients.

4. The number of roentgen-ray examinations is materially lessened.

5. Emergency cases of fractures may be more easily handled.

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

THE FIFTH AVENUE HOSPITAL CLINICS. First series, based on the material from the semi-monthly staff meetings, 1925. Cloth. Price, $5.00. Pp. 336, with 67 illustrations. New York: Paul B. Hoeber, Inc., 1927.

This book is of great interest and importance, consisting as it does of a group of papers, the subjects of which have a wide range. It differs from the average text in two essential details. The ordinary book is usually a formal presentation of material that has been hashed and rehashed for a greater or lesser number of years by all the reputable technical magazines; furthermore, it is the work of one, or seldom more than two men. It elaborates one subject or sketchily covers several. This volume, on the other hand, is the composite work of a large group of thoroughly trained men. The subjects of the various chapters, running as they do almost the whole gamut of medical specialties, makes it of peculiar interest to both the general practitioner and the specialist. Above all, the material is recent. All the current diagnostic and therapeutic methods are used; their results are herein reported; important discussion of each paper is included with it. Its value is obvious. The Fifth Avenue Hospital patients should, however, get more benefit from the publishing of such volumes than any one else. It automatically calls for more careful and better work on the part of the staff. The publication of these clinics immediately increases the number of critics a thousandfold, some of them not particularly kind and most of them rather searching. A higher standard of work results inevitably with the ultimate benefit to the patient. A perusal of this book is apt to arouse a strong desire to be present at some of these clinics.

H. S. HOFFMAN.

LEITFADEN DER ZAHNÄRZTLICHEN RÖNTGENTECHNIK. (Introduction to Dental Roentgen Technique.) By Dr. J. Schindler, Zahnarzt, Dozent am zahnärztlichen Institut d. Universität Bern. Cloth. Price, 3.90 Marks. Pp. 99, with 76 illustrations. Leipzig: Georg Thieme, 1927.

In order to keep abreast with the modern progress and developments in dental science, the practicing dentist must devote more and more attention to dental roentgenology; and this presupposes a knowledge of at least the elements of the subject. The aim of this little handbook is to present briefly the fundamental aspects of roentgenology as applied to dental science.

The subject is discussed under the following headings: The physics, nature, properties and origin of roentgen rays; the practical production of roentgen rays and apparatus for their generation; the hazards of roentgen practice in dentistry; the principles of projection; special technique of dental roentgenography; exposure time; and dark room technique. Dr. Schindler has covered the more important aspects of practical dental roentgenography adequately, albeit briefly owing to limitations as to space. The printing is clear, and numerous diagrams excellently executed, add much to the utility of this manual which is designed essentially for the beginner.

B. COHEN.

BOOKS RECEIVED

THE FIFTH AVENUE HOSPITAL CLINICS. First Series, based on the material from the semi-monthly staff meetings, 1925. Cloth. Price, $5.00. Pp. 336, with 67 illustrations. New York: Paul B. Hoeber, Inc., 1927.

ESSAI SUR UNE NOUVELLE RADIOLOGIE VASCULAIRE. By Manoel de Abreu. Paper. Pp. 215, with 58 figures, 6 photographs and 36 teleroentgenograms. Paris: Masson & Cie, 1926.

DIE RÖNTGENTHERAPIE DES CHIRURGEN. By Dr. Hans Rahm, Privatdozent der Chirurgie an der Universität Breslau. Paper, price 48 Marks; bound, price, 50.50 Marks. Pp. 547, with 205 illustrations. Stuttgart: Ferdinand Enke, 1927.

RÖNTGENTHERAPEUTISCHES HILFSBUCH, FÜR DIE SPEZIALISTEN DER ÜBRIGEN FÄCHER UND DIE PRAKTISCHEN ÄRZTE. By Dozent Dr. Robert Lenk, Assistent am Zentralröntgenlaboratorium des allgemeinen Krankenhauses in Wien. Third, enlarged edition. Paper. Price, 4.80 Reichsmark. Pp. 81. Vienna: Julius Springer, 1927.

LEITFADEN DER ZAHNÄRZTLICHEN RÖNTGENTECHNIK. By Dr. J. Schindler, Zahnarzt, Dozent am zahnärztlichen Institut d. Universität Bern. Cloth. Price, 3.90 Marks. Pp. 99, with 76 illustrations. Leipzig: Georg Thieme, 1927.

THIS BUSINESS OF OPERATIONS. By James Radley. Cloth. Pp. 96. Cincinnati: The Digest Publishing Co., 1927.

BONE SARCOMA: THE PRIMARY MALIGNANT TUMORS OF BONE AND THE GIANT CELL TUMOR. By Anatole Kolodny, PH.D., M.D., Department of Surgery, State University of Iowa. Cloth. Pp. 214, with 104 figures and 41 plates. Chicago: Surgical Publishing Co., 1927.

The Radiographic Diagnosis of Bilharziasis. By G. O. Lotsy, Member of the "Institut d'Egypte," Cairo. Text in English, French and Arabic. Price, 19.-Sh. Pp. 30, with 11 photographic plates (43 roentgenograms, 1 photograph) 11 plates with 42 schemes and 2 schemes in the text. Cairo: H. Friedrich & Co., 1927.

The Theory and Practice of Massage. By Beatrice M. Goodall-Copestake, Examiner to the Chartered Society of Massage and Medical Gymnastics, teacher of massage and Swedish remedial exercises to the nursing staff of the London Hospital. Fourth edition. Cloth. Price, $4.50. Pp. 267, with 72 illustrations. New York: Paul B. Hoeber, Inc., 1927.

The Quartz Mercury Vapour Lamp: Its Possibilities and Uses in Public Health and General Practice. By J. Bell Ferguson, M.D., D.P.H., Medical Officer of Health, Tuberculosis Officer and School Medical Officer County Borough of Smethwick. Cloth. Price, $2.50. Pp. 106, with 38 illustrations. New York: Paul B. Hoeber, Inc., 1927.

The Artificial Light Treatment of Children in Rickets, Anaemia and Malnutrition. By Katherine M. L. Gamgee, M.R.C.S. (Eng.), L.R.C.P. (London), D.P.H. (R.C.P.S.), formerly Assistant Medical Officer of Health for Maternity and Child Welfare, Hull. Cloth. Price, $4.00. Pp. 172, with 16 plates, 5 graphic charts and 33 illustrations in the text. New York: Paul B. Hoeber, Inc., 1927.

X-rays: Past and Present. By V. E. Pullin, Director of Radiological Research, Research Department, Woolwich, and W. J. Wiltshire, Research Department, Woolwich. Cloth. Price, $4.50. Pp. 229, with 43 illustrations. New York: Van Nostrand Co., 1927.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

ALLEN, BUNDY. An *x*-ray study of the development of the ossification centers of the skeletal system. *Radiology*, November, 1926, vii, 398–409.

The present study is limited to the principal bones of the wrist. There are numerous factors affecting the roentgen-ray study of the development of the ossification centers. Apart from any variation in the density of developing bone a great source of error lies in uncontrolled variation of the roentgenographic technique. The present study is based upon many hundred accurate measurements with a standard technique at the Department of Child Welfare, State University, Iowa City, Iowa.

The charts show that ossification progresses much more rapidly in females than in males up to approximately the eleventh year. From the age of eleven to fourteen approximately, the development in both sexes is equal. From the age of fourteen approximately, the ossification progresses much more rapidly in the male. It was found that ossification varies markedly in the right and left wrist of the same individual Those who are right handed may have an advanced ossification of the left carpals, and vice versa. No definite time has been observed for the beginning or completion of ossification, or the union of the epiphyses in children who are clinically perfectly normal. Variations may be observed in normal individuals to the same degree as may be found in clinically abnormal subjects.

The study of the ossification of the skeleton is one of the best methods of determining the age of a fetus born before term, of determining whether an infant is born at or before term, the age of an individual below the age of thirty, and these points may have a medico-legal importance. Such data may also be of value in the study of alleged injuries to the foot and ankle. Tables are appended giving the ossification of the bones of the upper and lower extremities.

ALTSCHUL, WALTER. Temporary relaxation of the diaphragm. *Acta radiol.*, 1926, vi, 69–84.

Mediastinal processes, especially tuberculosis of the lung pedicle, may lead to injuries of the nerves running through the mediastinum: the vagus and the phrenic. Injuries of this sort to the vagus have been frequently the subject of observation. Holler has referred to the connection between gastric ulcers and hilum tuberculosis and speaks of a "mediastinal complex." Leb has reported a form of atony of the stomach caused by tuberculosis of the lung pedicle. Complete injuries to the phrenic nerve have led to a complete paralysis of the diaphragm; and the findings at autopsy have been reported by Lorey and Neumann.

However, if injured hilic glands and other mediastinal changes exercise only a slight pressure or tension on the phrenic nerve the latter will be reduced in efficiency without suffering direct injury. In such a case there will result a form of illness which was observed in 38 cases and presented the following features: Clinically, there may be obscure symptoms of a predominantly thoracic type on the one hand (cough, difficulty in breathing, palpitation, etc.), or on the other hand, more of the abdominal type (fullness, pain in the epigastrium). The objective clinical finding is negative in a majority of the cases. The main symptom is first recognized at the roentgen examination, namely, a peculiar behavior of the diaphragm characterized by a difference in its position at different times of the day. The position of the right diaphragm does not change appreciably, but the left diaphragm which shows a fairly normal position in the morning reaches the same level as the right toward mid-day and occasionally rises as much as two fingers breadth above the right in the evening. It is impossible to demonstrate any connection between the position of the diaphragm and the ingestion of food.

In a number of these cases there is found a large air bubble in the stomach, or an inflated flexure. These accumulations of gas are secondary in nature and may perhaps be due to a simultaneous injury to the vagus. In the majority of the cases an enlargement of the hilic glands was found to be the cause of these injuries to the phrenic nerve. In the rest of the cases cancer of the esophagus, previous operations on the stomach, and more particularly changes on the aorta or on the left ventricle. There were a number of cases in which no pathological finding could be demonstrated either clinically or roentgenologically and it may be that in which cases adhesions were responsible for the injury. Experience in the treatment of this condition is as yet very slight. The author proposes the name diaphragma molle to designate this condition.

Armour, Donald. Surgery of the spinal cord and its membranes. *Lancet*, Feb. 26, 1927, i, 423–430.

In this lecture the author discusses the history of the subject in its broadest aspects, and lays special stress on the great progress made in recent years in neurological diagnosis and localization. A summary is given of the results obtained by pneumomyelography. A considerable portion of the lecture deals with the use of lipiodol in localization of lesions of the cord, the technique of injection, the question of irritation of the meninges by the iodized oil, the interpretation of the results, negative findings, and conflicting evidence where neurological and lipiodol levels do not correspond.

In discussing the place of myelography in diagnosis the author points out that in the past five years 98 per cent of the cases of spinal tumors in the National Hospital for Diseases of the Nervous System, London, were correctly localized by painstaking neurological examination. The following rules are proposed regarding the use of lipiodol in the diagnosis and localization of spinal cord compression: (1) Its use should in no way usurp the place of careful and repeated systematic clinical examinations of the patient, especially with reference to the sensory level, combined with laboratory tests of the cerebrospinal fluid. Recourse to it as a labor-saving device and a short cut to diagnosis and localization cannot be too strongly deprecated. (2) It should only be used after a subarachnoid block has been first demonstrated by the combined cistern-lumbar puncture method introduced by Ayer. (3) It should not be used unless the possible dangers and complications are outweighed by the more exact localization likely to be obtained. (4) Finally, in properly selected cases we have in lipiodol a definite aid in the study of spinal cord compression, which if used intelligently, will increase definitely our successful removal of spinal cord tumors at an early stage and thereby increase the percentage of cures and reduce operative mortality.

Atonna, Carmelo, and Morrissey, John H. Polycystic kidney. *Ann. Surg.*, December, 1926, lxxxiv, 846–854.

In the diagnosis and treatment of kidney conditions, medical and surgical, the rôle played by anomalies is very great, and these anomalies are always associated with pathology. Polycystic kidney occurs in a fair percentage of these cases and should be borne in mind for diagnosis. Three classes of polycystic kidneys are described. First, those in which the symptoms of renal insufficiency appear and the patient quickly succumbs. These cases are obviously discovered only at autopsy. The second group embraces those cases presenting symptoms of chronic nephritis. Diagnosis is difficult, especially if the cysts remain small. In these cases the kidney tissue undergoes an atrophic degeneration as the result of intracapsular pressure. The third type of case presents symptoms directing attention to the urinary tract. Cystoscopy and pyelography very quickly determine the nature of the disease.

Pyelography is an invaluable aid in diagnosis. It has been the authors' experience that the physical reaction to pyelography is determined by the amount of pathology within the pelvis. Cases with actual disease, and particularly those with a marked hydronephrosis, frequently have no reaction whatever. Cases of renal pain due to stone in which the obstruction has existed for a short time, experience great pain from the irritation of the sodium iodide on the mucosa. In so far as these cases of polycystic kidney have no pelvic involvement, the reaction is liable to be severe. In view of the possibility of this reflex suppression, one must consider carefully before employing pyelography. In one of the authors' cases, death occurred two weeks after pyelography and this should be charged against the procedure.

In the interpretation of the pyelogram it may be noted that the pelvis is stretched out to four and five times its normal length with the separation of the calyces at each pole where they are in turn stretched further apart. The general tendency is towards a longitudinal enlargement while the depth of the pelvis is sacrificed but slightly. The pyelographic shadow does not show quite the same lack of tone as that which can be made out in hydronephrosis and inflammatory dilatation of the mucosa. This apparent presence of elastic mucosa may be accounted for by the presence of distended cysts just beneath the pelvis. The stretching out of the calyces over these cysts probably accounts for their increased depth. Six cases are described.

Baldwin, C. H. Congenital dislocation of the knee joint. *J. Bone & Joint Surg.*, October, 1926, viii, 822–823.

The ease of treatment in early infancy is demonstrated in a case reported, which also shows as an end result a joint anatomically and functionally normal. The infant, normal in every respect except for the deformity of the left knee, was seen the second day after birth. The knee was held in a position of extreme hyperextension. The leg could be hyperextended so that the toes could be placed in contact with the chest. No patella could be palpated.

The roentgenogram showed an anterior dislocation of the tibia on the femur.

Ten days later under light anesthesia the dislocation was reduced and required little force. There was a distinct click felt as the femur slipped forward. The knee could then be flexed to nearly its normal limit. It was held in a position of about 90° flexion on a plaster splint. At the end of four weeks flexion was normal and extension was normal with no tendency toward recurrent dislocation. At the present time, $8\frac{1}{2}$ years after treatment, the knee presents no difference either functional or anatomical from that of the opposite side. In this case no patella could be palpated at birth while in the normal knee the patella is palpable at that time. At the present time the patella is normal both in size and contour in the patient.

BAŔSONY, THEODOR, and POLGÁR, FRANZ. A roentgen sign of psoas abscess. *Fortschr. a. d. Geb. d. Röentgenstrahlen*, May, 1926, xxxiv, 634–636.

Calcium deposits in abscesses in the thoracic region are not of much diagnostic significance because the roentgen diagnosis of the abscess in this region is easy and the detection of calcification is in the nature of an incidental finding. However, in the case of psoas abscesses, it has been found that deposition of lime may be the only sign on the roentgenogram indicating the nature of the pathologic condition. Moreover, when the abscess is so small that it is not clinically demonstrable the discovery on the roentgenogram of calcification may be the only sign of psoas abscess. Four illustrative cases are cited. The possibility in the case of larger abscesses of the presence of iodoform glycerine introduced for therapeutic purposes must be guarded against in interpreting the roentgenogram.

BENDOVE, RAPHAEL A. Silent pulmonary cavities. *J. Am. M. Ass.*, Nov. 20, 1926, lxxxvii, 1739–1742.

About half of all pulmonary cavities in tuberculosis are silent. That is, they lack all the classical signs of cavitation customarily described. These silent cavities are of at least two kinds: (*a*) absolutely mute, that is those which exhibit no adventitious breath sounds at all, and (*b*) relatively silent, that is such cavities which lack the classical cavernous sounds but manifest other adventitious sounds such as bronchovascular breathing and moist râles. The most important factors responsible for the variable signs of these cavities are obstruction of the afferent bronchus by fibrosis or mucopurulent material, soft, ragged capsules which fail to respond to the vibrations of the inrushing air, changes in medium of conduction of the breath sounds produced by surrounding pneumothorax and emphysema.

Physical observations should always be corroborated by roentgenological signs as this is the surest way of diagnosing the so-called silent cavities. The walls of certain of these cavities are very poorly outlined on the roentgenogram, though after the induction of pneumothorax when the secreta and débris are squeezed out from the cavernum its walls stand out conspicuously. The roentgenologic annular shadows are not confined merely to the pleura, as maintained by certain observers, but are definitely pulmonary cavities as has been proven by many necropsies. Furthermore, in all of these cases which were treated with artificial pneumothorax, the latter brought about alteration in shape and change in location with a gradual lessening of the size of the cavity leading to its complete obliteration which could never have occurred if the shadow in question was due to adhesions between the visceral and parietal pleura.

The prognosis of these cavities varies; the small, absolutely mute cavities are of a much more favorable prognosis than the relatively silent cavities with changeable physical signs. Frequent roentgenoscopic observations plus repeated physical examinations of the chest are necessary in order to formulate a correct prognosis.

BERNSTEIN, MAURICE A., and ARENS, ROBERT A. Diagnostic inflation of the knee joint. *Radiology*, December, 1926, vii, 500–506.

Pneumo-arthrosis, diagnostic inflation, is a valuable aid in the differential diagnosis of derangements of the knee joint presenting the symptoms pain, swelling or effusion and lameness. The method is simple and harmless and can be employed in out-patient cases. The gas used for injection is carbon dioxide, and care must be taken to avoid traumatization of the synovial membrane by the injection needle. A roentgenogram is taken before the CO_2 is introduced; 75 c.c. of gas is then permitted to flow in, when a gurgling sensation can be felt over the lower portion of the knee. This soon extends to the suprapatellar space. A soft crepitus can be elicited over the entire knee and the knee joint becomes distended. The needle is then quickly withdrawn and a film taken in the same position as before. There is some pain connected with the procedure but this is of short duration.

The procedure is useful in the diagnosis of tears of the ligamental structures of the joint,

displacements and tears of the cartilages, and chronic synovitis.

On examining an inflated normal knee joint, the area above the patella corresponding to the suprapatellar pouch is well defined and takes the form of a gall-bladder. The area between the articular surface of the tibia and femur immediately behind and below the patella is clear and slit-like. The space in the posterior compartment is clear and elliptical. Variation in outline and filling defects are brought about by infiltrative changes with obliteration of normal contour and outline. When a synovial change occurs in the suprapatellar space the area is markedly diminished and appears irregular. One can often see bands stretching across that space. The most important and most striking change takes place in the region between the tibial and femoral articulation, below and behind the patella. Here the space should appear slit-like in the lateral view with an occasional dipping-in corresponding to the anterior crucial ligament. When disease is present in the joint, this area may be completely obliterated or may be increased.

BLOODGOOD, JOSEPH COLT. Bone sarcoma—periosteal and diffuse type, and their diagnosis from benign lesions. *J. Bone & Joint Surg.*, October, 1926, viii, 727–749.

To be a diagnostician of bone diseases, one should constantly restudy the roentgenograms or lantern slides of cases, and these should be kept in readily accessible filing cases. One of the great obstacles encountered by the majority of roentgenologists is that they are dependent for a final diagnosis in operated cases upon a pathologist who may be neither interested nor expert in diagnosis. For example, the roentgenologist has been frequently told that the benign giant cell tumor is a sarcoma; and he naturally concludes that central sarcoma is common; even in the benign bone cyst the fibrous tissue removed from the wall has been diagnosed as sarcoma. Roentgenograms of bone lesions before they are valuable in the study of the diagnostic features must be associated with a verification of the diagnosis not only by the microscope but by the final result. In other words, in the study of the roentgenograms one learns most from those cases in which the diagnosis has been verified. It is dangerous to draw conclusions from roentgenograms from cases in which the ultimate condition of the patient is unknown, in which the pathology is relatively uncertain and when the patients are living after amputation of the limb.

Reports are given of a number of cases in which the bone lesions were roentgenographed and studied within a few weeks after the first symptom and the information obtained from these leaves the hope that diagnostic laws of general applicability may be evolved. Emphasis is placed on the growing importance of the frozen section to help in the diagnosis at operation.

When the lesion, periosteal or diffuse, is where it can be resected, or below the upper third of the femur where amputation becomes the method of choice, and if the clinical picture, roentgenogram and other laboratory findings cannot absolutely rule out sarcoma, there should be no delay. The object of the operation is to explore, get a piece for frozen section, stain with polychrome methylene blue and then decide the nature of the lesion. If it is sarcoma, resection or amputation is indicated. When a central tumor is explored and found not to be a bone cyst, the tumor tissue within the bone shell should be thoroughly removed with thermal and chemical cauterization; and in chondroma, myxoma and chondrosarcoma, if it can be demonstrated that the bone shell is involved, then there should be resection and bone transplantation. This is not necessary in the giant cell tumor, even when the soft parts are involved.

BROWN, LEWIS G. Mediastinal cyst. *Radiology*, November, 1926, vii, 436–438.

The patient, a married woman aged thirty-five, had had a thyroidectomy which was followed by pneumonia, the patient being confined to bed for seven weeks. Since then there has been continuous cough and copious expectoration of thick, foul sputum. There was marked loss of weight and energy. A roentgen examination showed a globular, non-pulsating mass $4\frac{1}{2}$ inches in diameter attached to the upper mediastinal shadow and closely related to the left main bronchus, through which it probably drained. It lay behind the bifurcation of the trachea and displaced the esophagus $1\frac{1}{2}$ inches to the right and backwards. The posterior wall of the shadow was about $1\frac{1}{4}$ inches from the posterior thoracic wall. An outline of the mass was transposed to an anatomical cross section of the region. The relation of the shadow to the mediastinum, its partial drainage through the bronchus and its even globular, nonpulsating outline suggested cyst.

Several attempts at aspiration were made, but unsuccessfully. With the assistance of an improvised arrangement of two roentgenoscopes at right angles, a small caliber needle was inserted safely through the posterior wall. The needled point being found well within the mass, aspiration was attempted but owing to

the thickness of the contents met with only partial success. A small amount of air was injected which proved by its change of position when the patient assumed various postures that the contents of the mass were fluid or semifluid. The surgeon followed up the needle, still in place, establishing partial drainage. There followed complete cessation of cough and expectoration and a rapid gain in weight and strength.

The patient was reexamined five years later and the empty cyst was found to be only slightly diminished in size. The distortion of the esophagus has remained practically unchanged. The patient refuses further operation and remains in excellent health. There is no cough nor expectoration but the tube is retained in position, drainage is practically nil, the dressing applied once or twice daily showing only a stain and the odor is scarcely noticeable. An attempt to remove the tube about two years ago demonstrated its impracticability at that time by a return of the symptoms.

Chandler, F. G., and Young, J. M. Lipiodol in pulmonary diagnosis: its uses and limitations. *Brit. M. J.*, Feb. 5, 1927, i, 228–230.

Lipiodol injections enable the diagnosis and localization of bronchiectatic dilatations with certainty, and in many cases it is the only method of proving the diagnosis. Its use enables the differentiation of bronchiectasis from lung abscess, from empyema with a bronchopleural fistula and from tuberculosis. With regard to the diagnosis of lung abscess and empyema with a pleural fistula, the help given by lipiodol is of a negative character. It does not appear to enter the pulmonary abscess but stops short of it; nor does it easily flow through the bronchial fistula into an empyema cavity.

Tuberculous cavities fill readily but it has been suggested that injections are undesirable in cases of pulmonary tuberculosis. In the opinion of the authors the method described is simple and harmless giving invaluable help in certain cases but possessing limitations. It is doubtful if there is any other picture obtained after lipiodol injection which can be considered unequivocally pathognomonic. The authors base this conclusion on their own admittedly limited experience with 50 injections. Eight of the cases are described very briefly. The method of injection employed by the authors has been almost exclusively through the cricothyroid membrane. The patient is cocainized and suffers little if any discomfort. Occasionally the patient may complain of the taste and smell of the lipiodol. In sensitive subjects the symptoms of iodism may occur. In one case there appeared a characteristic rash and in another an attack of asthma seemed to be precipitated. No other harmful effects have been noted.

Cole, W. H. Simultaneous cholecystography and determination of liver function. *Proc. Soc. Exper. Biol. & Med.*, March, 1927, xxiv, 500–502.

The dose of phenoltetraiodophthalein is 0.04 gm. per kilo of body weight and is given preferably in the morning intravenously on an empty stomach. The total dose need not exceed 2.5 gm. Lunch should be omitted, but if hunger demands, the diet should be limited to liquids without fats and low in protein. Water is allowed. Roentgenograms are taken 4, 8 and 24 hours after the injection. A specimen of blood is taken before giving the dye and half an hour afterwards. The blood is allowed to clot, preferably in an ice box, and then centrifuged. The serum is removed, alkalinized and compared with standards in a manner similar to the Rosenthal modification of the phenoltetrachlorphthalein test for liver function.

Retention of less than 15 per cent of the dye in the blood stream half an hour after injection of the dye, and less than 4 per cent one hour after injection is considered normal. Retentions of any greater amounts for the specified time are considered abnormal. The largest amounts of retention have been found in cases of cirrhosis with ascites and may be as high as 80 to 90 per cent half an hour after injection. Retentions almost as great have been seen in patients having acute hepatitis with cholangitis, usually with slight jaundice. An interesting and almost constant fact has been observed, viz., that a mild retention above normal ranging between 17 and 35 per cent is found in cases of cholecystitis. This is probably explained by the practically constant hepatitis accompanying cholecystitis.

Animal experiments are now being conducted to determine the comparative values of phenoltetraiodophthalein and phenoltetrachlorphthalein as agents for determining liver function. Only a limited number of experiments have been completed as yet, but in every case phenoltetraiodophthalein has shown retention as long or longer after production of the liver damage than has phenoltetrachlorphthalein and without producing any toxic effects. This factor of greater sensitivity of phenoltetraiodophthalein produced presumably by the larger dose would seem to be quite a definite advantage and has manifested itself in the few experiments conducted so far.

Ebaugh, Franklin G., and Mella, Hugo. The use of lipiodol in the localization of

spinal lesions. II. The local and systemic effects of the injection of lipiodol into the subarachnoid space. *Am. J. M. Sc.*, July, 1926, clxxii, 117–123.

A series of 13 cases was studied and it was found that a septic meningitis is produced following the introduction of lipiodol into the spinal subarachnoid space. These reactions were, however, transient, recovery occurring within three days. The cellular and globulin increase appear to be more severe among paretics. The occurrence of frequent bloody taps in lumbar puncture after injection appears to indicate a generalized congestion of the vessels.

The general systemic effects following the introduction of 2 c.c. of lipiodol into the spinal subarachnoid space varied from patient to patient. In 4 of the cases there resulted pain in the legs. A slight increase in temperature occurred in 3 other cases. In 1 case nausea and headache were present. The leucocytes were increased in only 4 cases and decreased in 8. Many of the patients showed general restlessness.

Evidence was obtained in 2 cases pointing to a holding back of lipiodol by the posterior roots. There was no evidence of any subarachnoid block in the 5 cases of paresis studied. The rest of the series comprised 3 cases of multiple sclerosis, 2 with histories of old back injuries and 3 with evidence of degenerative neurologic lesions. These cases are briefly cited.

ENFIELD, CHARLES D. X-ray evidence in the diagnosis of gastric and pulmonary syphilis. *Am. J. Syphilis*, October, 1926, x, 621–624.

In the author's opinion neither gastric syphilis nor pulmonary syphilis offers a sufficiently characteristic roentgen appearance to justify a diagnosis from the roentgen examination alone. Syphilitic patients may and do develop nonspecific lesions and they may well have pulmonary tuberculosis or gastric cancer. The presence of a positive Wassermann reaction, a definite specific history or even known clinically active syphilis should carry very little weight, if any, in the interpretation of the roentgen findings with regard to either the chest or the stomach.

ENFIELD, CHARLES D. Diverticulitis of the colon, with especial attention to the diagnosis. *Radiology*, November, 1926, vii, 371–378.

Carman was the first to formulate a scheme for the recognition and differential diagnosis of diverticulitis. Since his report roentgenologists have been finding diverticulosis in an increasing percentage of patients undergoing routine gastrointestinal examinations, as well as in patients having suggestive symptoms. Colon diverticula of clinical importance are always false, and acquired, that is, they involve only the mucosa and the serosa, the former being herniated through an opening in the muscularis. Thus, the diverticulum in its simple form consists of a small sac varying in size up to that of a hen's egg and lined with mucous membrane and covered over with peritoneum. There is more or less inflammatory thickening and adhesive peritonitis in those cases which have suffered repeated attacks of subacute inflammation. By far the most frequently involved part of the bowel is the sigmoid. Usually the herniations take place on the mesenteric or antimesenteric border, a fact which renders their recognition the more likely.

The typical subject of a diverticulitis is a male over forty years of age, considerably overweight and subject to chronic constipation. The proportion of males to females is about two to one, or perhaps a little greater. In the acute case the attack is often described as simulating a left-sided appendicitis. The diagnosis of acute attack is a matter for the surgeon and depends upon the existence of the typical attack plus the information obtained from the history, unless there is available a report of a previous roentgen examination which disclosed the condition in the quiescent stage. Except in the acute attack the diagnosis depends on the roentgen examination, since the history is at best only suggestive.

It is very desirable to take a preliminary roentgenogram of the entire abdomen over the Bucky diaphragm in the anteroposterior projection. This serves to establish the presence or absence of abnormal densities which might later in the examination happen to be so placed in relation to the colon as to simulate filled diverticula. Twenty-four hours after a barium meal the examination of the colon begins and may be terminated at this time by the administration of a barium enema; or the administration of the enema may be delayed until the second or third day. The residue from the meal should be examined both roentgenoscopically and roentgenographically before the administration of the enema. The characteristic appearance of the bowel which should excite a suspicion as to possible diverticula is what has been described as the "saw-tooth sigmoid." The diverticula may be filled and seen as extraluminal shadows after the barium enema. The persistence of filled diverticula after the bowel has emptied of barium is another characteristic sign. No confusion is apt to arise in the roentgenographic differentiation between uncomplicated cancer of the

bowel and uncomplicated diverticulosis. In the early case it is quite impossible to determine whether narrowing in a colon showing diverticulosis is due to the benign process alone or to an engrafted malignancy. Another interesting phase in differential diagnosis is the often overlooked possibility of a right-sided diverticulum causing attacks closely similar to acute cholecystitis.

FALES, LOUIS H. The relative value of the roentgen ray and physical signs in the diagnosis and treatment of pulmonary tuberculosis. *Am. J. M. Sc.*, July, 1926, clxxii, 382–393.

From a study of 411 cases, 60 per cent of which were found to be tuberculous, it is shown that the roentgen ray is a most important means of determining the existing pathologic conditions of the lungs. A parenchymal roentgen-ray lesion without physical signs is of great significance, for 53 per cent of such cases showed positive sputum. Physical signs without a parenchymal roentgen-ray lesion are of very doubtful significance for all such cases had a negative sputum.

Peribronchial infiltration as seen by the roentgen ray is of no importance in diagnosing pulmonary tuberculosis since it was not found in any case in combination with positive sputum. On the other hand, parenchymal infiltration when visualized roentgenographically is of great importance, for 68 per cent of such cases had a positive sputum. In a certain percentage of cases the roentgen ray will show a lesion not demonstrated by physical signs as proven by the above comparisons, there being 11 per cent of cases with involvement of the second apex not shown by physical signs.

The roentgen ray more often presents a greater involvement (35 per cent) than is shown by physical signs (5 per cent). The parenchymal roentgen-ray lesion and râles usually occur together, this combination taking place in 93 per cent of the cases in this series, while peribronchial infiltration and râles are almost never found in combination, occurring in 1.6 per cent of cases.

Serial roentgenograms taken at two to six months' intervals portray the changing pathology of the tuberculous lungs, thus giving an insight into the progress and prognosis which can be obtained in no other way. The time is at hand when the clinician must be trained in the roentgenoscopic pathology of the lungs. It is just as important that he make his own roentgen-ray interpretations as it is that he make his own physical examinations.

We must discard the idea that peribronchial thickening when it reaches the periphery, and infiltration of the hilum have any significance in the diagnosis of pulmonary tuberculosis. Clinicians and roentgenologists who still believe in this theory are causing much confusion and misunderstanding and have brought great disrepute on the true value of the roentgen ray.

The material for this study was obtained from the entrance examinations at U. S. Veterans Hospital No. 50, Whipple Barracks, Arizona, from June, 1923 to August, 1924.

FIFIELD, LIONEL R. Diverticulitis. *Lancet*, Feb. 5, 1927, i, 277–281.

A study was made of 218 post mortem examples of diverticula and diverticulitis and 52 clinical cases of diverticulitis at the London Hospital. Acquired diverticula of the large intestine may be found in any part of it. The commonest site is the pelvic colon. In the great majority of the 218 cases the pelvic colon was the part affected, but diverticula were found in every part of the large gut including the rectum. They were usually multiple, sometimes numbering hundreds, but occasionally only one was present. They varied in size from that of a grape to that of a grape seed. They were essentially hernial protrusions of the mucosa and submucosa through the circular muscle at those sites of perforation of the latter by vessels where subserous fat was present.

In the 218 post mortem cases inflammation was present in only 5. Of the 52 clinical cases of diverticulitis about half were definitely obese and a small percentage were thin and wasted while about one-fourth of the patients alleged a recent loss of weight. The majority gave a history of constant constipation. In both the above series males were more frequently affected than females.

The clinical features of acute diverticulitis have been described as those of acute appendicitis in the left iliac fossa. They include the usual general constitutional disturbance with elevation of temperature, pulse rate, etc., and pain, tenderness and rigidity in the left iliac fossa with or without the presence of a lump. Sometimes these signs and symptoms were in the hypogastrium or right iliac fossa. There were 7 cases of acute diverticulitis in the majority of which a diverticulum had perforated.

Diverticulitis must be considered a definite possibility in all patients over the age of thirty who have inflammatory trouble in the left iliac fossa, signs and symptoms suggesting carcinoma of the colon, vesico-colic fistula or peritonitis of unknown origin. Sigmoidoscopy is not usually helpful in diagnosis on account of the difficulty in passing the instrument sufficiently high up. The roentgen examination is often

conclusive. The diverticula are best seen after the barium enema has been evacuated, the bowel then being empty, but the diverticula retaining their barium for days. Sometimes a long irregular tunnel stricture is seen and is characteristic. The treatment is surgical and the prognosis will depend on the condition of the patient when first seen.

FLICK, JOHN B. Lung abscess. *Ann. Surg.*, September, 1926, lxxxiv, 323–336.

Our knowledge of lung abscess has been increased markedly in recent years owing to the aid furnished by roentgen rays, the bronchoscope and more frequent operation. The symptons vary with the cause of the disease and with the stage. Foul breath and foul sputum are very constant signs, although lung abscess in rare instances occurs without either. The physical signs are much less reliable than history and symptoms in arriving at a diagnosis. Abscess following pneumonia may be very difficult to diagnose because it is obscured by the already existing pathology. However, if intermittent fever develops with chills and sweats, or fever develops after a decline, lung abscess should be considered as a possibility. The aspiration abscess is easier of diagnosis. The chronic type of abscess of insidious onset and undetermined etiology, especially if it involves the upper lobe, may be confused with tuberculosis. In such a case, only the absence of the tubercle bacillus on many sputum examinations would indicate the possibility of chronic abscess.

Bronchiectasis may be difficult to differentiate from chronic abscess. Here, however, the bronchoscopist by direct inspection and by bronchoscopic pneumography can furnish valuable aid. Abscess, gangrene and bronchiectases sometimes coexist, and it becomes a question as to which is the predominant condition.

The roentgenogram is almost indispensable as a means for accurate diagnosis of lung abscess. The most characteristic appearance is a roughly circular shadow of variable size surrounding a central rarefied area. The margins may be moderately well defined or represented by a zone less dense and perhaps mottled, which gradually merges into the normal. Not uncommonly the shadow is cone shaped with the base at the periphery. One or more cavities may show in the plates, and if partly empty, frequently a fluid level can be made out. The roentgenogram shows well the extent of the inflammatory reaction. Roentgenoscopic examination and stereoscopic plates determine the location of the abscess and its relative proximity to the chest wall, a matter of great importance when considering operability. Roentgenographic examinations should be made at several sittings if possible, before a final conclusion is reached, and lateral views should be included in this examination. A negative roentgenogram does not exclude abscess which may be hidden by the heart or diaphragm. In such an event additional information might be obtained by introducing lipiodol through the bronchoscope and re-examining roentgenographically. Bronchoscopy in conjunction with the roentgen ray will go far in helping to differentiate lung abscess from other pulmonary conditions. Insufflation of dry bismuth subcarbonate through the bronchoscope by the Jackson method preliminary to roentgen examination outlines the bronchi and demonstrates any bronchiectatic condition that may exist. This pneumography or "lung mapping" is advisable in most cases of suspected chronic abscess before beginning any kind of treatment. In a number of the author's cases the point of maximum tenderness on percussion seemed to correspond fairly well with the point selected by the roentgenologist as the best site for drainage.

The treatment of pulmonary abscess demands the close coöperation of the internist, the bronchoscopist, the roentgenologist and the surgeon. The first principle here, as in suppuration elsewhere, is the establishment of drainage. The prospect for cure depends on the establishment of either natural drainage or drainage by surgical measures. The operative results are decidedly better in the acute than in the chronic cases and the mortality is lower. The general mortality varies from 15 to 35 per cent. The etiology has a decisive and direct bearing on the prognosis. The postoperative cases are the most favorable. A fair number of post-tonsillectomy cases recover spontaneously. The disappearance of symptoms and signs, however, must not be regarded as a cure, for roentgen examination will often reveal a smoldering area that may at any time be rekindled. In metastatic abscesses the prognosis is bad. Much depends on the individual resistance of the patients, the virulence of the organisms, the early recognition of the condition, the prompt and proper selection of treatment. Throughout the course of the disease there hangs the shadow of complications more serious than the disease, the principal of which are brain abscess and pulmonary hemorrhage.

GEIPEL and SAUPE. On the development of sirenomelia. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, May, 1926, xxxiv, 623–633.

An anatomical study was made of a monster with fusion of the lower limbs. The abnormal development extended from the pelvis where the ischium was fused with the pubis to the

lower extremities where the fibulae and calcanei were also fused. The case was studied roentgenologically and except for the sacrum showed in the osseous system no differences from the normal. The os sacrum was found to be inclined at a sharp angle to the back and upward forming an open angle of 90° with the lumbar portion of the vertebrae. The number of vertebrae of the os sacrum was normal. The distribution of the blood vessels was studied, especially that of the umbilical artery which is regarded as normal and not as a vicarious omphalomesenteric artery.

Ghormley, Ralph K. Joint disease. *J. Bone & Joint Surg.*, October, 1926, viii, 858–883.

There is presented a series of cases of joint disease where an effort was made to reach a final positive diagnosis. Tuberculosis is the predominating disease in this series, because the author believes that the diagnosis in this is of prime importance. Some of the difficulties in the way of making a positive diagnosis are shown even in cases where biopsy was performed. It is emphasized, however, that biopsy stands at the surest means of diagnosis known at present. The guinea pig test is of value, but in the present series did not show up well, probably on account of the method of inoculating the guinea pigs. Of the other available aids in diagnosis, the tuberculin test deserves first mention, a negative reaction being strongly against a diagnosis of tuberculosis.

The roentgen ray in the earlier cases is of little help and in complicated cases is of little or no value except to show the extent of the disease. The history and physical examination are of the utmost importance when carefully done, and of great aid, and in a fair proportion of cases give information sufficient for a correct diagnosis.

This series includes 135 cases gathered over a period of two years in the Orthopedic Department of the Massachusetts General Hospital. In addition to tuberculosis, the other conditions represented are osteochondritis dissecans, giant cell tumor of the tarsal scaphoid, syphilis, prepateller bursitis, "Brodie's abscess" and gonorrheal arthritis. In most of these cases the roentgenographic evidence was helpful in establishing the diagnosis. It was found that there may be extensive bony involvement by tuberculosis without any appreciable change in the roentgenogram. In one case the head of the astragalus was found to be quite extensively involved by tuberculosis but yet there was scarcely any perceptible roentgenographic change. The only thing seen in the early cases may be atrophy, together with some thickening. The enlargement and squaring of the epiphyses so often quoted as characteristic were not seen in these cases. As the disease advances, the picture becomes more definite, with increased transparency of the bone, areas of irregularity along the joint line and in the bone. The later cases, especially those in which secondary infection has supervened or the surgeon has intervened, show wide variations from any constant picture. In the author's experience only cases fairly well advanced without secondary infection or surgical intervention present anything like a characteristic picture.

Gottesman, Julius, and Benedick, Arthur J. Pneumopericardium from radium necrosis. *Am. J. M. Sc.*, 1926, clxxi, 715–719.

A report is given of what is apparently the first case of pneumopericardium produced by radium necrosis and definitely demonstrated by the entrance of barium into the pericardial sac. The patient suffering from adenocarcinoma of the stomach developed a pneumopericardium with organized pericarditis following a fistula formation between the cardia of the stomach and the pericardial sac. This fistula followed some time after the administration of 30 mg. of radium in needles for fifty hours into the cancerous mass at the cardiac end of the stomach. The pneumopericardium developed in several months and was diagnosed by typical clinical signs and roentgenologically by the entrance of barium into the pericardial sac during a gastrointestinal examination. The clinical findings were confirmed at autopsy.

Habbe, J. E. X-ray findings in a large ventral hernia. *Radiology*, December, 1926, vii, 511–512.

Ventral hernias are seldom referred for roentgen study since the diagnosis by physical examination is usually quite easy. A report is given of a case in a woman aged thirty-seven, in which the roentgen diagnosis was made because of hindrance offered to the usual physical examination. The woman weighed well over 200 pounds although only 5 feet 3 inches tall, and had had a salpingo-oöphorectomy through a low midline incision. She was suffering from right lower quadrant pain associated with occasional nausea and vomiting. Constipation was severe. On physical examination, the fat sagged forward and downward like a short apron and made it impossible to determine whether this "apron" was simply excess fat or a herniation of abdominal contents within a peritoneal sac. Roentgen examination showed the entire ileum herniated forward and downward, occupying a constant position entirely in the right half of the anterior abdominal wall. The bowel loops appeared to lie no

deeper than an inch beneath the skin in this region. There was no demonstrable marked narrowing of the space occupied by the barium-filled loops of bowel in the upper part of the hernia and this suggested a relatively large "neck" for the sac. Herniotomy was successfully performed, and the patient made an uneventful recovery.

HEALEY, C. W. A case of spondylitis deformans with myositis ossificans. *Lancet*, Jan. 22, 1927, i, 174–175.

A report is given of a case occurring in a seaman aged twenty-seven which is of interest because of the difficulty of early diagnosis, the extreme rarity of the concomitance of two in themselves rare diseases, and the perfect symmetry of the osseous changes. The patient complained of pain and stiffness in the back of the neck and pain on pressure over the ribs, and later developed great pain in the left temporal, occipital and clavicular regions. When admitted to the hospital he was unable to sit down, the head was held facing half right and there was complete "poker back." The shoulders, elbows, wrists and hand joints were normal, but the hips were immobilized and the knees could not be flexed more than 60° from the straight position. The chest expansion was only from $30\frac{3}{4}$ to $31\frac{1}{4}$ inches.

Roentgenograms taken about this time showed apparent fusion of the articular processes in the cervical and other regions of the spine with some ossification in the cervical portion of the anterior common ligament, an absence of bone changes at the shoulder joints (the hip joints could not be clearly seen), and apparently perfectly symmetrical myositis ossificans of the glutei maximi. No other groups of muscles were similarly affected, and the hands and feet were normal.

Treatment has consisted in administration of iodine in many forms, in massage and exercises. The head at present can be bent laterally about 5° and turned similarly. The spine can be moved very slightly even with great and prolonged exertion on the part of the patient, but the knees can be flexed to 90°. The temperature, pulse and respiration have remained normal throughout.

HEARD, JAMES D., SCHUMACHER, F. L., and GORDON, W. B. Association of diabetes insipidus with osteitis fibrosa polycystica. *Am. J. M. Sc.*, 1926, clxxi, 38–48.

A case is reported in which occurred the exceedingly rare association of osteitis fibrosa polycystica with diabetes insipidus.

A child, previously normal, received a head injury at the age of twenty-one months. At the area of contact a swelling developed which was probably at the outset a hematoma, but which when operated upon four months later was found to contain apparently necrotic tissue. The operating surgeon believes now that the tumor was a bone cyst. Two weeks subsequent to operation there appeared evidence of involvement of the first lumbar vertebra and the ilium, involvement of other bones being noted from time to time subsequently. Examination of a fragment of tissue curetted from the diseased area in the ilium failed to lead to a histological diagnosis but Dr. David Silver believed that clinical evidence supported a diagnosis of osteitis fibrocystica. Roentgenographic examination of individual bones or of the entire skeleton was made at intervals, and the roentgenologist believes that upon the results of these roentgen-ray findings alone a diagnosis of osteitis fibrosa polycystica can be made. Comparison of earlier with later roentgenograms shows that the bone disease has lessened in severity during the period of observation.

Diabetes insipidus developed nine months after the head injury and at a time when the generalized bone disease was well advanced. It was found that the polydypsia could be controlled by hypodermic injections of pituitrin. One c.c. was injected on alternate days throughout a period of eight months during which time the child has shown marked subjective and objective improvement. The authors speculate on whether this association of diabetes insipidus with the bone disease is accidental or due to some common cause.

KAMPMEIER, R. H. Duodenal diverticulum. *Am. J. M. Sc.*, October, 1926, clxxii, 590–594.

Diverticulosis of the duodenum has been found in about 1 per cent of cases in extensive series of barium meal studies, occurring usually in patients past middle age. Only about 3 per cent of these occur in the first portion of the duodenum. Duodenal diverticulum cannot be diagnosed clinically. It has been without exception found at roentgen-ray examination.

A report is given of a case of diverticulum of the first portion of the duodenum. The pouch was found to be of comparatively large size and contained all coats in its wall. Because of the fact that the sac could be so easily emptied by manipulation during the roentgenoscopic examination, it is considered probable that this lesion was never associated with very extensive inflammatory pathology. This is further borne out by the fact that the pouch was easily mobilized at operation and was found to have only a few adhesions. This case was further of interest because the patient, a woman, was relatively young (36 years).

Another unusual feature was the association of a definite group of clinical symptoms with the diverticulosis. There was pain in the epigastrium coming on two to four hours after meals, this pain being dull in character and associated with a sense of fullness in the epigastrium. The roentgenoscopic examination showed the opaque meal, upon passage through the stomach into the duodenum, filled rapidly into a large pouch descending from the greater curvature of the bulb. This was smooth in contour and could be easily emptied by manipulation but filled again with the next peristaltic wave. The second portion of the duodenum was demonstrated as lying above and to the left of this pouch. At six hours the stomach was empty, the diverticulum still retained some of the barium meal. At twenty-four hours the diverticulum was empty and the barium meal was in the colon.

Kantor, John L., and Sagal, Zachary. Colitis as a common disorder of digestion. *Am. J. M. Sc.*, November, 1926, clxxii, 707–713.

Simple, nonspecific, nonulcerative colitis (colonic irritability) is a common disorder of digestion which is often overlooked by both patient and physician. The diagnosis can be made clinically, by stool examination and roentgenographically. On physical examination the patient usually shows tenderness over the various parts of the colon and very often over the entire abdomen. Localized tenderness in the right iliac fossa or right hypochondrium is not uncommon and is very misleading. The proctosigmoidoscopic examination is always useful. The examination of the gastric contents after a test meal may prove to be helpful inasmuch as an achylia or marked hypochlorhydria when present is generally related to the associated colitis. In an overwhelming majority of cases a mere glance at the stool is sufficient for all practical purposes. Given a stool which is mushy in appearance, contains an excess of mucus, gives evidence of fermentation by the presence of numerous small gas bubbles on the bottom and sides of the jar, is strongly acid in reaction, has a penetrating sour odor, and the rest of the examination is superfluous or merely confirmatory.

One aspect of the roentgen diagnosis of colonic irritation has to do with the rate of emptying of the bowel. If there are evidences of stasis, a diagnosis of some variety of constipation is indicated. If, on the other hand, the colonic transit is hastened, there exists a state of irritability. Colitis may therefore be diagnosed or at least suspected from the following roentgen findings: (1) at the six-hour observation the head of the barium column is beyond the splenic flexure; (2) at the nine-hour observation the head of the column is in the pelvic colon or rectum with or without the passage of a stool containing barium; (3) at the twenty-four-hour observation the colon is empty. In addition to the abnormalities of function, there are interesting changes in colonic form as revealed by examination of the sacculi or haustrations. In colitis there is either irregularity or complete absence of the haustrations, lending an atypical, beaded, mottled or smooth appearance to the colon, as the case may be. Similarly suggestive is a scattered filling of the colon or actual filling defect, provided that obstructive neoplasm is excluded. This finding occurs characteristically in tuberculous colitis. Increased gas content of the large intestine is likewise suggestive of colitis. Stasis in the terminal ileum is a strikingly common finding in colitis. This may be diagnosed in one of two ways: (1) at the six-hour examination no barium has passed the ileocecal junction (relatively rare). (2) At the nine-hour examination barium is still present in the terminal ileum.

The prognosis of colitis is guarded but improves in proportion to the precision of diagnosis and the persistence of treatment. The therapy is primarily dietetic but general hygienic measures, certain medicaments, hydrotherapy, and possibly actinotherapy are often of value.

Karelitz, Samuel. Unusual forms of periosteal elevation. *Am. J. Dis. Child.*, March, 1927, xxxiii, 393–403.

Painful extremities and joint swelling occurring in leucemia and allied conditions are suggestive of periosteal elevation and cortical erosion, and roentgen-ray evidence of this condition should be sought. A case of neuroblastoma with periosteal infiltration is presented, with roentgen-ray evidence of periosteal elevation and wide separation of cranial sutures. In another case the periosteal elevation was associated with leucemia. Periosteal elevation which is non-syphilitic and non-scorbutic in childhood should suggest the possibility of leucemia or allied conditions, or neoplasms such as neuroblastoma. The case associated with leucemia occurred in a boy aged three; the neuroblastoma was in a boy aged two and a half years. An autopsy in the latter case yielded the diagnosis of ganglioneuroma and neuroblastoma arising in the paravertebral sympathetic plexus and the preaortic ganglion; metastases of neuroblastoma in the skull, brain and kidney; multiple gliomas of the brain; pinealoma.

KEITH, D. Y., and KEITH, J. PAUL. Typhoid osteitis and periostitis. *J. Am. M. Ass.*, Dec. 25, 1926, lxxxvii, 2145–2148.

Typhoid bone infection is probably much more frequent than has been recorded. It is not seen frequently nowadays because of the decrease in typhoid incidence in recent years. It can be recognized in the long bones by its location in the diaphysis, usually some distance from the epiphysis and by the small area or areas of involvement with so little adjacent bone reaction.

Roentgenologically, the simplest process in the long bones is a localized periostitis with a small abscess which may be multiple, usually situated in the cortex just adjacent to the periosteum. It is rarely larger than 1 cm. in diameter, is circular or oblong in appearance and casts a shadow of lesser density than the surrounding bone. The limited area may suggest the etiologic factor, as may the slight immediate bone reaction.

While the involvement is limited in the periosteum, the cortex may show extensive involvement which may spread for several centimeters. The limit of periosteal involvement is usually much less than is present in syphilitic periostitis with its marked osteosclerosis. The bone destruction is much less than in metastatic staphylococcus bone infection so frequently seen in young and adolescent patients.

Typhoid spine gives very constant roentgenographic changes that can and should be recognized. The changes seen are destructive ones in the bodies of the vertebrae with absorption in the intervertebral discs which are thinner and blurred. Later, new bone deposits are seen around the vertebral bodies, with exostosis laterally to the spine and with bony deposits in the vertebral ligaments. Frequently clasp-like bony projections are seen laterally connecting the bodies of the vertebrae. Bone deposits in the lateral ligaments may show when the first symptoms are experienced by the patient.

From a careful review of the cases reported, the first changes seen are thought to be in the intervertebral discs follows by an involvement of the body of the vertebrae and lateral margins with exostosis and bony deposits in the adjacent lateral ligaments. In the anterior film there is a general mottled appearance over the lateral ligament areas, extending to the external margins of the shadow of the psoas muscle. There is usually a history of mild trauma followed by excruciating pain on either passive or active movement, the patient begging not to be disturbed. Roentgenologic differentiation in typhoid spine is based on the dense bony deposits in the lateral ligaments with evidence of narrowing of the intervertebral spaces.

Three illustrative cases are cited.

KIRKLAND, A. STANLEY. Non-secretion of tetraiodophenolphthalein. *Radiology*, December, 1926, vii, 512–513.

Brief reports are given of 2 cases suffering clinically from gall-bladder disease, who failed to give a cholecystographic shadow of the gall-bladder but who on operation did not have gall-bladder disease. In both cases laparotomy was performed and in both cases the gall-bladder was found to be normal in the gross. The wall was not thickened, the color good, and the viscus emptied freely upon gentle massage; but there was a large amount of disease in the neighborhood. The liver in both cases was very largely replaced by carcinoma. In one case there had been a carcinoma removed from the pelvis a few years previously; in the other no primary growth was discovered. Neither of these patients showed jaundice. Both died within two months after the laparotomy.

KNAPPENBERGER, GEORGE E. The *x*-ray in cardiac diagnosis. *Radiology*, October, 1926, vii, 297–305.

The roentgen examination of the heart and the blood vessels has supplied us with facts that are invaluable, yet most of them can be elicited clinically. Like the electrocardiograph it is essential only in diagnosing specific cases. Both methods add mathematical accuracy to careful observation and reasoning. The author reviews some of the possibilities of roentgen-ray diagnosis of lesions of the heart and great blood vessels. The review includes a discussion of the cardiac shadows in the (1) anteroposterior view; (2) right anterior oblique position; (3) left anterior oblique position. Brief descriptions are given of the roentgenographic appearance of left ventricular hypertrophy, left ventricular hypertrophy and dilatation, mitral disease, tricuspid insufficiency and stenosis, chronic nephritis and arterio-sclerotic heart, cor pulmonale, drop heart, aortic enlargement, and cardiac arrhythmias. The congenital defects are omitted from this discussion since they constitute a subject in themselves.

LEWALD, LEON T. "Cyclic vomiting" in infants and children. *Radiology*, November, 1926, vii, 410–415.

In a series of about 200 infants and children referred for roentgen examination on account of chronic disorders of the digestive tract, a history of recurrent or cyclic vomiting was obtainable in at least one-third of the cases, which were nearly equally divided as to sex. A previous

diagnosis of acidosis had been made in at least 20 per cent.

The predominant roentgen findings related to the colon, particularly redundancy; pylorospasm, dilatation of the stomach and gastric ptosis were frequent additional findings. Roentgen evidence of chronic appendicitis sufficient to warrant operation was encountered in only a very few instances. The appendix should never be removed for supposed chronic appendicitis and to find the exact location of the appendix. Forty-eight cases of left-sided appendix have been found on roentgen examination by the author, associated with either complete transposition of the viscera or non-rotation of the colon.

In one case in which the gastrointestinal tract was negative, operation for correction of internal strabismus cured the vomiting attacks. In 2 cases the appendix had been removed previously without relief.

Cyclic vomiting is not an entity and has no specific cause. It is probably of reflex nature and is usually associated with abnormalities in some portion of the digestive tract. Three illustrative cases are briefly cited.

Lindsay, Janvier W., Rice, E. C., and Selinger, M. A. Bone changes in congenital syphilis. *Am. J. Syphilis*, January, 1927, xi, 118–126.

In infants, roentgen-ray examination of the long bones particularly, is a valuable aid in the diagnosis of congenital syphilis. Bone lesions occur in a large majority of such cases and with greatest frequency in patients under one year of age. The bone changes which occur depend for the most part upon the time at which the affected part becomes involved. Frequently no knowledge of the presence of osseous changes will be had without a roentgen examination. In the very young infants the most common variety of lesion is the so-called productive periostitis. It occurs in the shafts of the long bones and the periosteum becomes very definitely thickened and irregular in outline and appears to be elevated from the surface of the bone proper. There is no actual production of bone substance in this condition, the pathology being confined to the periosteum itself. In some cases there may be an associated osteitis. The second most common lesion is the destructive bone process. This always occurs at the head of the bone. It is this type of lesion which is responsible for the cases of pseudoparalysis that come to notice. Osteochondritis is also an early lesion which is not rare.

The above observations are based on a study of 94 cases made at the Children's Hospital, Washington, D. C. Seven of the cases are briefly cited and some of the more typical bone lesions are pictured.

McKee, Edward N. Gastric ulcer demonstrated by the gas-filled stomach: case report. *Radiology*, October, 1926, vii, 342–344.

The patient, an unmarried woman, aged twenty-three, entered the hospital with a temperature of 105.6°, and the following chief complaints: headache, abdominal pain, lumbar pain, vaccination on right thigh. The reaction from vaccination appeared to account for all the symptoms, but after the vaccination had receded evidence of pathology in the upper abdomen remained quite marked.

The roentgenogram showed both kidneys normal in size and position with no evidence of calculus. Examination of the epigastric region including the upper border of both diaphragms revealed the gas-filled stomach. The shadow included both diaphragms and extended down to the fourth lumbar vertebra. The diaphragms were apparently normal. There was a calculus about the size of a French pea in the region of the pelvis of the right kidney. The stomach was well outlined being markedly distended with gas. The pylorus was well up under the right costal margin, while the cardiac portion pressed the left diaphragm. Under this was seen a heavily outlined gas-filled transverse colon showing in both the hepatic and splenic flexures. There was an irregular break in the outline of the stomach on its outer curvature at about the juncture of the cardiac and antral portions. Whether this indicated an old gastric ulcer or not could not be decided definitely but the incisurae were very prominent. This examination was done with a portable roentgen apparatus because it was impossible to move the patient. The diagnosis was a probable perforating ulcer. The patient was immediately operated on and at examination there were found enlarged lymphatic glands around the lesser curvature of the stomach and a distinct ulcer on the lesser curvature of the stomach with some yellowish exudate sealing over its surface. There was a thin watery fluid in this area but no evidence of fat necrosis. Upon introducing the finger into the foramen of Winslow a number of cobwebby adhesions were felt. The patient made an uneventful recovery.

A similar case in a man aged twenty-four revealed in the roentgenogram a very large gas-filled stomach with marked incisurae and evidence of gastric ulcer. The patient was operated upon immediately and a perforating ulcer was found.

MACKOY, FRANK W. Family diverticulosis of the colon. *Radiology*, December, 1926, vii, 498–499.

Eight members of a family, in three generations, suffered from chronic intestinal trouble that presented similar clinical pictures in all cases. By roentgen examination a diagnosis of diverticulitis of the colon was established in 2 of the cases (sisters), and a symptomless diverticulosis was demonstrated in a third sister.

MCPHEDRAN, F. MAURICE. The diagnosis of tracheobronchial tuberculosis. *Am. J. M. Sc.*, February, 1927, clxxiii, 245–258.

Study of post-mortem material shows that calcium infiltration is the sole distinctive roentgenographic indication of the site of a lymph node situated within the limits of the mediastinum. Calcium-free glands, however enlarged, fail to cause perceptible intensification of the mediastinal shadow. The protrusion of the mediastinal wall beyond the shadow of the spine and sternum by caseous lymph nodes is rare except in fatal infantile cases. Intrapulmonary glands must contain calcium to be recorded roentgenographically. When they are large, that part of their calcium-free margins which projects beyond the arterial main stem will be recorded by contrast with the pulmonary parenchyma. It appears that reabsorption of calcified caseous necrosis within lymph nodes does not occur. Shadows simulating calcification are thrown by vessels seen endwise. No symptom-complex has been found characteristic of tracheobronchial tuberculosis. Respiratory symptoms due to uncomplicated tracheobronchial disease do not occur. The quantitative tuberculin reaction gives important indications as to the activity of the lesion in the individual. It is of unique value in infancy. It gives indispensable information regarding the source of infection, ignorance of which frustrates alike treatment and prophylaxis of tuberculous disease at its most tractable phase. The term tracheobronchial tuberculosis is preferable to hilum tuberculosis because as has been pointed out by Opie, the former describes accurately the glandular element of the complex primary infection.

MATHER, J. H., and WILLIAMS, W. ROBERT. Cholecystography. *Brit. M. J.*, Apr. 2, 1927, i, 614–615.

The results of 125 consecutive cases examined by the oral administration of the dye are reported. The success of the oral method depends on obtaining a reliable salt, careful coating and preparation of the capsules which must be freshly used, together with an adequate roentgenographic technique and intelligent cooperation on the part of the patient. The oral method is easier than the intravenous so far as the preliminaries are concerned and yields equally satisfactory results from a roentgenographic point of view. The procedure is devoid of risk and the toxic effects are negligible. The surgical findings confirmed the roentgen diagnosis in 33 out of 35 cases (over 94 per cent).

There were 56 cases showing a normal gall-bladder and operation in 4 of these cases revealed stones in one of them. There were 53 cases showing no shadow and 25 of these were operated on with but one gall-bladder found normal; the rest showed distinct evidences of pathology. Three cases showed irregularity or deformity of the shadow and operation in one of these disclosed an inflammatory mass at the pylorus. Eight cases showed non-opaque stones and operation in 4 of these confirmed the roentgenographic diagnosis. There were 5 cases showing a delay in emptying, and operation in one of these showed a dense mass of adhesions at the neck of the gall-bladder.

MATTES, ABRAHAM. Bilateral pyelo-ureterograms. *J. Am. M. Ass.*, Jan. 1, 1927, lxxxviii, 16–19.

Bilateral pyelography properly done is safe and is attended with no danger to the patient. In more than 1200 cystoscopies made since January, 1924, bilateral pyelograms were taken in more than 229 cases with no attending fatality or any really serious complications when small amounts of fluid were used. The pelvic sac should not be distended. The flat sac method of instillation is physiological, and does not distend the pelvis nor interfere with its function. The interpretation of the data will be false if the functions of the pelvis and ureter are disturbed. A mild degree of stasis can always be determined by time pictures. The taking of time pictures may eliminate the use of bougies for determining the presence of stricture or spasm in the ureter. Pain referable to the kidney area frequently shows on examination no more than retention of the pyelographic medium. So-called pelvic stasis reponds to drainage and dilatation with cessation of symptoms.

The capacity of the kidney pelvis as determined in several thousand cystoscopies is never more than 2 to 3 c.c. and usually is 1 c.c. or less. The emptying time of the pelvis is from three to five minutes. The author advocates the following procedure which is harmless and yields valuable information: (1) There is no need to prepare the patient in any special way; (2) small opaque ureteral cathe-

ters are used; (3) small amounts of opaque fluid are instilled, and (4) greater concentrations of opaque medium are to be used, such as 40 per cent sodium iodide. The small catheters permit lateral drainage, do not block the ureter and do not disturb the waves of contraction. Higher concentrations of sodium iodide permit of dilution by the urine without appreciably cutting down the shadow density.

Mayer, Ernst G. The technic of the roentgenologic examination of the temporal bone. *Radiology*, October, 1926, vii, 306–317.

Suitable for roentgen examination are all those diseases which either lead to change in the air content of the cellular system, analogous to infections of the paranasal sinuses, or which change the structure of the bony portions in any way. These diseases may be grouped as follows: (A) inflammatory affections; (B) malignant tumors extending from the middle ear cavities; (C) basal tumors with destruction of the pyramids; (D) fractures; (E) acquired changes in the auditory canal; (F) congenital maldevelopments; (G) operative defects.

In acute otitis media we are concerned only with those cases in which the diagnosis is uncertain. One can determine roentgenologically the character of the pneumatization, the structure of the cellular system and its extent. The most important fact to be elicited is the presence or absence of destruction of the cell walls from suppuration. Chronic otitis leads to changes in the cavities of the middle ear, particularly in the attic and mastoid antrum. The presence and extent of bone destruction can be determined and at the same time the relation of these processes to the floors of the middle and posterior cerebral fossae. Poor development of the pneumatic system is the rule in chronic otitis. In tuberculosis of the ear the roentgenologist must distinguish between those cases in which the bony changes are limited to the immediate vicinity of the middle ear and those in which the pyramids are involved to a considerable extent. In the one group we must bring out particularly the cavity of the middle ear, and in the other the entire pyramid.

Tumors which extend from the pars mastoidea destroy first the neighborhood of the middle ear cavities and then under proper conditions speedily involve the labyrinth or extend through the internal canals toward the tip of the pyramid. In these cases not only the cellular system and the middle ear cavities must be examined but also the entire pyramid with the labyrinth. Basal tumors in the majority of instances lead to a destruction of the tip of the pyramid.

Fractures usually extend through the squama, auditory canal and tympanic cavity or through the squama, mastoid antrum, aditus and tympanic cavity towards one of the larger foramina of the middle cerebral fossa. Acquired disease of the auditory canal includes exostoses, hyperostoses and atresias. Congenital malformations affect mostly and to the greatest degree the os tympanicum, although rarely the pyramid or the mastoid process may be involved.

For a comparison of the healthy and diseased parts it is necessary to picture both on a single plate. Two such projections can be used with the temporal bone, one for the mastoid process and the other for the pyramids. The mastoid comparison is made with the patient prone; forehead and nose on the plate. The central ray runs through the line where the sagittal plane meets a plane running parallel to the German horizontal plane but through the upper margin of the orbit. (The German horizontal plane goes through the lower margins of both orbits and the upper edges of both external auditory meati.) The diaphragm is of the iris type, upper end 7 cm., lower end 14 cm. in diameter, skin target distance, 35 cm., filter 0.5 mm. Al. The pyramid comparison is obtained with the patient supine, head supported on a sandbag and the central ray going through a line of intersection of sagittal plane with the German horizontal. The diaphragm is of the large iris type, upper end 7 cm. and lower end 12 cm. in diameter. The skin target distance is 45 cm., filter 0.5 mm. Al. These comparison roentgenograms give symmetrical pictures of the desired type.

Brief descriptions are given of the three important techniques for roentgenographing the temporal bone, namely, the Schüller, the Stenvers and the Mayer. These three special exposures reveal all essential details. The Schüller technique brings out the mastoid process, the tegmen and sinus and the external auditory canal; the Stenvers technique brings out the pyramid and labyrinth and the mastoid process; the Mayer technique brings out the middle ear cavity and the external auditory canal. For producing the sharpest and clearest possible films the Potter-Bucky diaphragm may be employed with all the methods above described except the technique of Mayer. In this, one cannot correct for the markedly eccentric position of the tube by a corresponding change in the position of the head. The author employs a long conical tube of circular cross section with the upper opening about 3 cm. in diameter and the lower about 6 cm., the entire cone being about 30 cm. long. The various methods described have been in use

now for over three years and have demonstrated their value in a large number of patients.

MIXTER, CHARLES G. Urinary obstructions in childhood. *Ann. Surg.*, October, 1926, lxxxiv, 533–548.

Obstruction of the urinary outflow in childhood is far more common than has been generally recognized. The urinary stasis is followed sooner or later by infection and progressive renal destruction from back pressure and inflammatory changes.

The urinary obstructions are chiefly due to congenital anomalies and may be caused by intrinsic lesions of the urinary tract or by pressure from without. Intrinsic lesions are situated most commonly at the ureteropelvic junction, the vesical orifice or the region of the verumontanum in the male urethra. Causes of pressure from without on the urinary tract are usually anomalous renal vessels or reduplication of the pelvis and ureter. Megalo-ureter produces urinary stasis and renal impairment. The etiology is in doubt but it seems probable that an obscure obstructive lesion either in the posterior urethra or at the ureterovesical junction associated with a secondary infection offers a satisfactory explanation. It is generally bilateral, and the ureteral orifices are normal but are not competent to drain adequately the enormously dilated ureters.

In any type of lesion encountered it is imperative to relieve the obstruction to the urinary outflow at an early stage in order to prevent extensive renal destruction. In the majority of cases this destructive process is already far advanced before an accurate diagnosis can be established. Cystoscopy, cystograms and ureteropyelograms are indicated in childhood in all cases suggesting obstructive urinary lesions or showing persistent or recurrent pyuria. The routine examination performed by the author is as follows: After the usual urinary, renal function and blood chemistry studies, a cystogram is made with 20 c.c. of 12 per cent sodium iodide in both the anteroposterior and lateral positions to ascertain the presence of the ureteral reflux, dilatation of the posterior urethra or diverticulum of the bladder. A cystoscope is then passed, both ureters are catheterized and pyelograms are made. The catheters are then withdrawn to the lower ureter and ureterograms are made. The ureters are then drained and a final film is taken. This will show whether there is delayed emptying of the pelvis or any portion of the ureter. The divided renal function test has been unsatisfactory as the catheters used are necessarily so small that there is urinary leakage around them, thus vitiating the test. Cystoscopy can usually be carried out in girls over eight or nine years of age and in boys over eleven years under local anesthesia. In younger children a general anesthetic is required.

MORLEY, JOHN. Cardiospasm. *Lancet*, Feb. 26, 1927, i, 431–433.

The various names under which this condition has been described—cardiospasm, achalasia of the esophagus, idiopathic dilatation of the esophagus, phrenospasm, hiatal esophagismus,—indicate how little is known with regard to its essential nature and causation. The author presents brief descriptions of 4 cases.

The diagnosis is made in part by the clinical history, as the absence of corrosive poisoning will eliminate the ordinary fibrous stricture, while the long duration of symptoms, the greater trouble with fluids than with solids, and the age of the patient will often help to exclude carcinoma. The roentgenographic appearance however, is characteristic and should always make the diagnosis plain. The roentgenogram will show great ballooning of the esophagus, the barium meal being held up in the lower end of the tube.

Although there is no well-defined anatomical sphincter at the lower end of the esophagus comparable with that controlling the pyloric outlet, there can be no doubt as to the presence of a physiological sphincter. It is the persistent failure of this cardiac sphincter to relax, both during and after deglutition, that gives rise to the symptoms. The theory of Chevalier Jackson that the obstruction is due to a spasm of the right crus of the diaphragm must be rejected, since division of the right phrenic nerve in cases of cardiospasm has failed to affect the obstruction. Until we know the real cause of the condition treatment must be essentially palliative.

NESSA, N. J. Diaphragmatic hernia: Case report. *Radiology*, October, 1926, vii, 342.

The patient, a woman aged sixty-five, had been complaining for the ten years previous of vague distress in the epigastrium following meals. There was no history of any injury nor of jaundice. There was occasional vomiting several hours after meals and there was slight anemia.

The roentgen examination by barium meal revealed the following: stomach shows clearance in six hours. Barium enters stomach at a point below the diaphragm and fills up to the pars cardiaca and then passes through a narrow opening into a portion of the stomach above the first portion, apparently located above the diaphragm, and then returns to a point near the

spine where it enters the duodenal bulb. This case was diagnosed as diaphragmatic hernia, probably congenital.

NOBACK, G. J. The thymus in the newborn and early infancy. *Radiology*, November, 1926, vii, 416–421.

Anatomical findings demonstrate that the broad type of thymus is characteristic in the late fetus and in the stillborn child. This broad thymus is gradually molded by the expanding lungs following birth. Roentgenological studies as reported in the literature show that "enlarged" thymus glands are found unaccompanied by clinical symptoms. Consequently it does not seem correct to diagnose the broad-shadow thymus as "enlarged" or hypertrophied in the newborn and in early infancy when it is but slightly less frequently found than the narrow-shadowed thymus, especially in the absence of clinical symptoms. The conclusion is reached that the broad-shadow thymus is probably as "normal" as the narrower one in the absence of clinical symptoms or knowledge that the thymus compresses the structure posterior to it. Symptoms pointing to the thymus seem to indicate roentgen therapy regardless of the width of the thymic shadow.

O'BRIEN, FREDERICK W. The roentgen ray diagnosis of subdiaphragmatic abscess. *Boston M. & S. J.*, March 13, 1927, excvi, 518–523.

The roentgen diagnosis of subdiaphragmatic abscess is a comparatively simple matter but this fact is not generally known, which must be the case if early diagnosis is to be made. The two kinds of subdiaphragmatic abscess seen are the so-called simple type and that containing gas. The abscess is almost always unilateral due to the natural protective barrier of the falciform ligament which prevents extension from the right to the left or vice versa. The physical signs may be complicated by upward extension of the process through the diaphragm giving rise to serous pleurisy or empyema, factors which also complicate the roentgen diagnosis of the condition.

Normally the right leaf of the diaphragm is higher than that on the left. This disproportion is most evident at full inspiration. With the patient standing the highest point of the dome lies at the upper edge of the fifth rib on the right and at the lower edge of the fifth rib on the left. Roentgenograms should be made with the patient's breath held at full inspiration, and, if done in a patient suffering from simple diaphragmatic abscess without complications above the diaphragm, the leaf of the diaphram on the affected side will be found to be elevated in marked disproportion to that of its fellow. The contour of the diaphragmatic dome will be found to be smooth and regular; the costophrenic sulcus clear and the lung fields normal. On roentgenoscopic examination there will be noted immobility of the diaphragm on the affected side. In the differential diagnosis one must consider the normally high placed diaphragm of the stocky individual.

In the gas-containing type of abscess without complications above the diaphragm, the diaphragm on the affected side will be found higher than normal, its contour regular, the costophrenic sulcus clear, the lung fields clear, but in addition beneath the diaphragm will be found a semicircular area or clear space representing the gas bubble.

ORR, CLIFFORD R., and JABOBS, WILLIAM F. Pulmonary fibrosis. *Radiology*, October, 1926, vii, 318–325.

A brief discussion is given of pulmonary fibrosis and pneumoconiosis as an occupational health hazard. The various forms of pneumoconiosis do not give pathognomonic pictures and while roentgen examination is not essential to a proper diagnosis, such examination coupled with a complete and careful history of the case will make for greater accuracy in diagnosis. Roentgenograms will give no inkling as to the kind of dust inhaled nor will they differentiate between the causes of fibrosis, except by a process of elimination. For instance, in an uncomplicated case of pneumoconiosis the roentgenogram will show increased linear markings which are diffuse, bilateral and symmetrical and which extend to the periphery with corresponding increased glandular changes at the hila. Cases of cardiac disease, tuberculosis, syphilis, influenza, pneumonia and other respiratory infections will result in these changes, but consideration of the clinical findings and history will lead to correct interpretation.

The roentgenologist will seldom, if ever, come in contact with a primary stage of fibrosis which is manifested by acute respiratory disturbances and is registered roentgenographically by increased hilum and root shadows. In the second or latent stage the lung has for a time accustomed itself to the presence of dust and gives no symptoms until later when the roentgenogram reveals the characteristic mottling due to development of the condition and symptoms of pulmonary embarrassment make their appearance.

The third, or chronic stage, is characterized by marked fibrosis, bilateral pulmonary semiconsolidation with areas of aeration at the apices

and bases, thickened pleura, lowered resistance and poor circulation—conditions predisposing to bronchiectases, tuberculosis, abscess gangrene and even to primary carcinoma supposedly due to the fibrous tissue cutting off islands of lung tissue.

PANCOAST, HENRY K., and BOLES, RUSSELL S. Nontraumatic left diaphragmatic hernia. *Arch. Int. Med.*, Nov. 15, 1926, xxxviii, 633–646.

The more general employment of the roentgen ray with its recent advances in diagnosis makes it apparent that diaphragmatic hernia must have been frequently overlooked in the past. Symptoms may be entirely absent. Physical signs may be absent, particularly in the hernias through the esophageal opening. Frequently asymmetry of the chest with protrusion of the affected side and displacement of the heart or lungs may be observed. The diagnosis has seldom been made clinically. It can be made readily by the roentgenologist, however, and if made early the patient will often be spared an unnecessary operation for some other suspected cause of his illness.

In making the roentgen diagnosis, examination should be made after a barium meal, first with the patient in the erect position to obtain anteroposterior and oblique views, and then observation should always be made in the horizontal position. It appears that these hernias are frequently overlooked because the fundus is not filled and the patient's position is not changed. Repeated attempts to fill the herniated portion of the stomach may be necessary, and more than one examination. Subsequent examinations of the colon should be made to determine whether or not it is included in the hernia. The roentgenologist can help determine the type of treatment by observing the size and location of the hernia, the symptoms when the hernial sac is filled, and noting the amount of dilatation of the esophagus. The examination should suggest the site for operation, whether above or below the diaphragm, by disclosing the position of the diaphragm, the width of the angle at the ensiform and the extent of ossification in the costochondral junction. In making the roentgen examination, the length of the esophagus may sometimes be determined but esophagoscopy is frequently the only exact method.

Sixteen cases were discovered by one of the authors in approximately 9000 gastric cases studied during the past thirteen years. Fifteen were nontraumatic and on the left side. Twelve were through the esophageal opening, 3 were central and 1 was probably central. One of the cases with central hernia was traumatic.

When symptoms are present, they are usually gastrointestinal but may be respiratory. The most common and suggestive symptom is pain above the ensiform or in the epigastrium, which comes on particularly in the recumbent position and at night. Regurgitation when in the supine position usually accompanies the pain. Surgery offers the only line of treatment. The 16 cases are briefly cited.

PORTER, WILLIAM B., and MCKINNEY, J. T. Phytobezoar diospyri virginianae with report of a case. *Am. J. M. Sc.*, November, 1926, clxxii, 703–706.

The patient, a white male aged thirty-five, was admitted to the hospital complaining of distressing gastric symptoms which had existed for thirteen months. While out hunting the year before he had eaten freely of persimmons and was positive he had not swallowed any of the seed. A few hours after the meal he was seized with epigastric pain, nausea and vomiting but at no time did the vomitus contain any part of the persimmons. The acute symptoms lasted about a week. Following the acute symptoms the patient had boring pain and burning in the stomach thirty minutes to two hours after meals.

The roentgen-ray examination of the gastrointestinal tract with barium meal showed a ptosis of the stomach, the lower border of the greater curvature extending in the standing position about 3 inches below the crest of the ilium. Hyperperistalsis and hypermotility were noted. An area of lessened density about the size of a lemon and having the appearance of a large air bubble was seen in the stomach. This area was not coated with the barium mixture and was seen to change its position in manipulation of the stomach. Six-hour examination showed about one-fourth of the barium meal remaining in the stomach, surrounding but not coating over the area of lessened density. Reexamination of the patient three days later showed no change in the roentgen-ray findings. It was concluded that this area of lessened density was due to a mass of foreign material in the stomach, and, interpreted in the light of the clinical history, was most probably a ball or mass of persimmons, and operation was advised. This mass was removed and weighed 59 grams. It was black with an irregular surface having much the appearance of a lump of coke. A section of the specimen showed that it was composed of the fibers and skins of the persimmon, equally distributed suggesting that it was formed promptly and no addition was made

to it from ingested food. The patient recovered and has remained free from gastrointestinal symptoms.

PUGH, WINFIELD SCOTT. Ureteral calculi. *Ann. Surg.*, December, 1926, lxxxiv, 855–866.

Ureteral calculi are the result of obstruction plus infection. One of the most important factors in stone production is the proteus bacillus. Many ureteral calculi pass through the ureter spontaneously but many become impacted. The most frequent point of impaction is in the lower third. A calculus once impacted may shut off the flow of urine but does not necessarily do so since a drainage groove may be present in the stone.

Calculus seems to be a disease of middle life and the analysis of 100 consecutive cases upon which this report is based shows a predominance of the disease in women. Hematuria and pyuria are present in almost all cases. The calculi found in about 95 per cent of cases are solitary.

Ureteral dilatation should always be tried in those cases in which a marked pyelonephritis is not present or in the absence of other contraindications. Dilatation of the ureter has been found successful in from 60 to 90 per cent of the cases; and when this procedure is unavailing extraperitoneal ureterolithotomy is the operation of choice.

From the standpoint of diagnosis the atypical type of case was distinctly more frequent in the series reported on. About 80 per cent of ureteral stones will show clearly on the ordinary roentgenogram, but it is often impossible to tell definitely if they are in the ureter. The taking of a roentgenogram with an opaque catheter in the ureter is helpful but not entirely conclusive. The double exposure method has been used extensively by the author. In case of a possible ureteral stone the opaque catheter is passed in the usual way. The Coolidge tube is then centered and a picture taken in the usual way. The tube is then moved about 2 inches off center or inclined slightly and a second exposure made. When the stone is in the ureter it follows the ureteral shadow, or in other words, appears in the same relation in both exposures.

A brief review of the history of the etiology of the disease is presented and a bibliography of 37 references is appended.

RHINEHART, D. A., and RHINEHART, B. A. Congenital abnormalities of the stomach. *Radiology*, December, 1926, vii, 492–497.

A report is given of a case of simple inversion of the stomach, a type which seems not to have been reported in the literature. This occurred in a woman aged sixty-five who complained of defective elimination and a slight discomfort over the entire abdomen. The roentgenographic examination showed a rare form of congenital malformation of the stomach. In its development the stomach must have changed end-for-end by rotation around a transverse axis, the greater curvature and the pylorus passing forward and upward along the anterior abdominal wall into the under surface of the left arch of the diaphragm. Apparently this occurred at a rather late stage in development. It probably took place after the descent of the cecum and after the large intestine had reached adult form. The high position of the transverse colon and its intimate relationship to the greater curvature of the stomach leads to the belief that the great omentum had formed, and that the colon was elevated as a part of the process which inverted the stomach. Because of the lack of abnormal roentgen findings in the stomach itself it is not believed that the childhood malaria and enlargement of the spleen in this case could have produced the deformity.

A remarkable feature of this case is that the patient should have lived to the age of sixty-five with such an inverted stomach and with such few symptoms. The uneasy sensations within the abdomen and the fact that she could not eat so hearty a meal as a normal person were the only symptoms attributable to the stomach. The uneasiness was due to the peristalsis, and the lack of distensibility was probably due to pressure on the diaphragm. In emptying of the stomach gravity did not play even a minor rôle; emptying was entirely the result of muscular activity.

ROBINS, S. A., and JANKELSON, I. R. Cardio-esophageal relaxation. *J. Am. M. Ass.*, Dec. 11, 1926, lxxxvii, 1961–1964.

Cardio-esophageal relaxation is not a clinical entity but is found in a great variety of pathologic conditions or unassociated with any demonstrable lesions. It must be differentiated from other lesions in or about the lower esophagus such as hernia, pouch or cardiospasm. The dilatation was found to be of two distinct types, tubular and globular, the type depending probably on the degree of reflux, on its duration or possibly on the gastric muscle tone or intragastric pressure. The open cardio-esophageal orifice and to-and-fro passage of barium meal can occur, in the opinion of the authors, only if the muscles governing this opening are relaxed, hence the name cardio-esophageal relaxation. The condition occurs most commonly in females, and in the 103 cases observed by the authors the proportion of females to males was three to one. No pain was present

in any case. There were 8 patients who had the symptom of heartburn and 6 of these had a definite pathological condition to account for it. This leaves only 2 cases of heartburn associated with the relaxation. This fact is taken to mean that the escape of stomach contents into the lower esophagus is not the cause of heartburn.

Cardio-esophageal relaxation is demonstrated roentgenologically by the following technique: The ordinary barium meal is given, consisting of 125 gm. barium sulphate in 350 c.c. buttermilk. The patient is instructed to drink slowly. The esophagus is studied under the roentgenoscope with the patient in the vertical right oblique position while drinking the barium mixture. Then the routine examination of the stomach is made. Later the stomach is studied in the prone, supine and oblique positions. The cardio-esophageal region is closely studied and the patient is directed to take a deep breath, which often facilitates the observation. Roentgenograms are taken in the position in which the reflux was best observed under the roentgenoscope.

SARGENT, JAMES C. The roentgen ray in urology. *Radiology*, Dec., 1926, vii, 480–491.

The roentgenologic aspects of urinary lithiasis are discussed. The consistency with which stones of the urinary tract cast clear, definite shadows on the roentgen film at once makes such a means of investigation paramount in the diagnosis of this condition. However, not all shadows suspected of being stone shadows are caused by urinary stones. Hence the greatest danger of error in the diagnosis of urinary stones lies in the very ease and simplicity of roentgenography. After all, urinary stones are not always a disease in and of themselves, but they are frequently found occurring as a complication of more fundamental urinary pathology.

Bitter experience has shown that the diagnostician who depends solely on the plain roentgenogram in the investigation of urinary stones not only does so at the risk of occasional gross error but in so doing fails in an appreciation of the real worth of the roentgen ray in urology.

The danger in the diagnosis of urinary stones from the plain plate lies in two facts. In the first place, shadows are frequently encountered on the film mimicking closely those produced by urinary stones and caused by some one of a number of other factors. Phleboliths, enteroliths and calcified lymph nodes are but a few of the many extra-urinary causes of shadows easily confused with those of urinary stones. In the second place, the mere knowledge of the presence of a stone is but a small part of the information necessary in the management of a case of urinary lithiasis. In a large number of cases of stone, especially in the kidney, it is almost as important to know where the stone lies in the kidney and what the condition of that kidney is as to know of the presence of the stone itself.

A discussion is given of a series of illustrations of common types of misinformation given at times by the plain roentgenogram, the ease and simplicity with which such errors may be avoided, and the great amount of information hidden within the plain plate to be revealed only by the pyelogram.

SAYERS, R. R. The effects of silica dust upon the lungs. Part 1. *Am. J. Pub. Health*, March, 1927, xvii, 208–214.

There is good empirical evidence that dust containing a high percentage of free silica is most dangerous; furthermore, only the very fine particles reach the lung tissue and remain there. The cardinal symptom of silicosis is shortness of breath, especially on exertion. The cardinal sign is diminished expansion of the chest. These symptoms are slight in the early stages. Cough is not considered a cardinal symptom. Recurrent colds and pain in the chest are also important symptoms. The roentgen-ray findings are of great aid in diagnosing silicosis.

Pancoast and Childs in this country and Steuart in South Africa have had extensive experience with the roentgenology of silicosis and their findings may be summarized as follows:

The first change noted in the roentgenogram of a man developing silicosis is enlarged hilum shadows. In simple silicosis the changes are almost symmetrical throughout both lungs except that the shadows are usually more marked toward the right base. These findings may be due to other causes and a definite diagnosis of silicosis in an individual case cannot be made at this time from the roentgenogram without the support of clinical findings. In the second stage the hilum or root structure shadows are much denser and larger, the finer shadows found in early silicosis have increased in number and density, are less regular and look beaded. Sometimes the effect is described as a generalized mottling. In the third stage the entire area of both lungs is covered by many discrete, well-defined rounded shadows.

SCHLUETER, S. A. Avulsion of the lesser trochanter. *J. Bone & Joint Surg.*, October, 1926, viii, 766–768.

Strong muscular contractions not uncom-

monly produce fractures of the bone. Avulsion of the lesser trochanter of the femur belongs to this class and because of the rarity of this lesion the following case is reported. During a baseball game the boy, aged fourteen, had stopped abruptly and while attempting to keep his body upright experienced sudden severe pain in the left hip which forced him to lie down. Walking was very painful. The left thigh was held in 90° flexion and any attempt to straighten out the limb produced pain and muscle spasm. Other passive movements of the hip could be performed if carried out slowly and carefully. There was no swelling but a definite point of tenderness could be elicited when pressure was applied over the lesser trochanter. A roentgenogram of the hip showed an avulsion of the lesser trochanter. In addition to a complete severance of the latter from the left femur there was a marked displacement upward of the bone fragment. Three days following the injury a plaster hip spica cast was applied with the hip fixed in 45° flexion and slight adduction. After several months the patient had full return of function in the injured limb.

The lesion can be easily recognized by (1) the nature of the injury; (2) a localized point of tenderness over the lesser trochanter; (3) the inability to flex the hip while in a sitting position; (4) the absence of shortening of the affected limb, and (5) the roentgenographic evidence of the misplaced lesser trochanter.

Schumacher, Forrest I. Observations on reduplication of kidney pelves and ureters, with a case report. *Radiology*, December, 1926, vii, 475–479.

While congenital anomalies of the kidneys and ureters are of no clinical significance, the fact that they are more prone to be pathological makes their detection all the more important. A duplicated ureter is almost invariably accompanied by a duplication of the kidney pelvis. In such cases, the kidney itself may be fused, or double, or of the horseshoe type. The discovery of duplication of the ureters and pelves is frequently made with the cystoscope and from the roentgenogram. In the diagnosis of such anomalies, which is not always made at the first examination, the closest coöperation is necessary between the surgeon, urologist and roentgenologist. Perhaps the first intimation of abnormality is the unusually large amount of opaque medium injected before the patient becomes conscious of distress. The roentgenogram at this time may or may not reveal the reason for the abnormal capacity. Roentgenoscopic control in such cases is obviously of great advantage.

A report is given of a case in a colored woman aged twenty-eight in whom there were found two pathologic pelves on the same side, and apparently of the same size. The branching of the ureters was found to occur on both sides just above the bladder wall. The dilatation of both right ureters and pelves accommodated so much of the fluid that the second and third examinations were necessary in order to delineate the entire tract. Even with 26 c.c. of fluid injected into the right ureter there was no hint at the first roentgen examination of an anomalous formation.

Shands, A. R. An analysis of one hundred *x*-rays of patellae in children between the ages of two and one-half and six years with especial reference to the center of ossification and a report of one case of delayed ossification of the patellae. *J. Bone & Joint Surg.*, October, 1926, viii, 824–831.

An absence of the ossification center of the patella was found in 32 of the 100 cases from the Orthopedic Department of Johns Hopkins Hospital.

It is significant that there were twice as many boys as girls with no ossification center present, and that all cases over $4\frac{1}{2}$ years old were boys. Tuberculosis has a definite effect on the development of the ossification of the patella. Rickets has a definite effect on the time of appearance of the ossification center, while congenital syphilis has no constant effect on either the development of ossification or the time of appearance of the ossification center.

Delayed appearance of the ossification centers of the patellae was observed in a boy aged five years three months, and a thorough study of all the factors in the case shows undernutrition of the patient as the most outstanding factor. The roentgenographic examination of all the bones showed no ossification centers present for the patellae which should be present at the third year. No ossification centers had appeared for the upper epiphyses of the fibulae, lower epiphyses of the ulnae; the trapezii and semilunars in the carpus, the second cuneiforms and naviculars in the tarsus, all of which should have appeared by the fifth year.

There were 2 cases with patellae having two definite ossification centers. The first case showed the second or smaller center situated at the apex of the patella and of about one-tenth the size of the larger center. In the second case, the smaller center was situated at the superior external angle of the patella and was about one-fifth the size of the larger center.

SICARD, J. A., and FORESTIER, JACQUES E. Roentgenological exploration of spinal and cerebral spaces, genito-urinary organs and other organic cavities with iodized oil. *Radiology*, November, 1926, vii, 385–397.

Lipiodol containing 40 per cent iodine has been found to be a relatively safe substance for injection for roentgenographic purposes. So-called light lipiodol consisting of a solution of lipiodol in olive oil has been proposed by Sicard and Binet for the purpose of outlining the lower level of the spinal obstruction. This preparation containing only 11 per cent iodine is introduced through lumbar puncture, the average dose being 5 c.c. It produces a more severe reaction than does ordinary lipiodol, causing headache, nausea and a rise in temperature. When there is no obstruction it ascends along the spinal canal and in two or three hours is seen in the cerebral ventricles.

Recently the attempt has been made to obtain better films of the cerebral ventricles by means of an emulsion of light lipiodol with the patient's cerebrospinal fluid. Five c.c. of the cerebrospinal fluid are withdrawn by lumbar puncture and while the needle is left in place and obturated, 5 to 8 c.c. of light lipiodol are pumped into the syringe and emulsified by shaking with the fluid. The emulsion is immediately re-injected. Roentgenograms of the ventricles are obtained within two or three hours. This method seems to give even better results than Dandy's air injections for the localizaton of brain tumors, but the reactions are stronger than with ordinary lipiodol, and not enough experience has as yet been obtained with this method.

Exploration of the arachnoid spaces is indicated only in cases of chronic radicular pain, even without paraplegia, provided the lumbar puncture shows an increase of albumin in the fluid without any cellular reaction. Operators are strictly warned not to perform any injection into the cisterna magna within less than ten days after a lumbar puncture. The roentgenograms must be taken in the vertical position; those taken horizontally are of no value. Several films should be taken within a few days from the time of injection. In case of non-pathological stoppage a part or the entire dose of lipiodol flows gradually down to the cul-de-sac. Lipiodol reveals the compression and gives an accurate localization, but the diagnosis of the cause of compression must be left to the clinical investigator.

Brief descriptions are given of the employment of lipiodol in the examination of the uterus and fallopian tubes, cold abscesses, the male urethra, vas deferens and seminal vesicles, facial sinuses, lachrymal ducts, biliary fistulae, intra-arterial injections in the case of gangrene of the extremities to localize clot or thrombus. On account of its quick absorption by the digestive mucous membrane, lipiodol is not to be used as an opaque medium for the exploration of the digestive tract in the same way as bismuth and barium are used. But the opacity of lipiodol and its relative fluidity have enabled Loeper, Forestier and Leforestier to use it as a test for the secretive activity of the stomach. The injection of lipiodol in the bone marrow and joints for therapeutic purposes has yielded peculiar roentgenograms. The shape of the capsule of the knee joint can be easily visualized after several intra-arterial injections of lipiodol which were accompanied with rather painful reactions. Lipiodol also finds employment for experimental purposes in the exploration of the permeability of the capillary network in animals.

STEIN, IRVING F., and ARENS, ROBERT A. Pneumoperitoneum in gynecology. *Radiology*, October, 1926, vii, 326–331.

Pelvic pathology can be clearly and definitely shown by diagnostic pneumoperitoneum. A direct and also a differential diagnosis of ovarian tumors may be thus established. The authors have employed the method of Peterson modifying it slightly with the addition of a Potter-Bucky diaphragm and have induced pneumoperitoneum in over 160 patients. Both the transuterine and transabdominal routes were employed, using CO_2 through a Rubin patency apparatus. An ordinary lumbar puncture needle is used in the transabdominal method.

A higher degree of accuracy in diagnosis is obtained by this method than is possible with the usual gynecological examination. While not advised as a routine procedure, pneumoperitoneum may often be utilized to settle differences of opinion which arise so frequently among gynecologists. As a matter of record and of legal evidence the films may prove of great value, whether positive or negative, both to the patient and to the physician.

STEWART, WILLIAM H. Some interesting observations on the oral method of cholecystography. *Boston M. & S. J.*, March, 31, 1927, cxcvi, 509–518.

The author employs tetraiodophenolphthalein, the fresh drug from the ampule being placed into 8 plain gelatin capsules which are dipped into a solution of keratin and allowed to dry. This seals them air tight and covers them with a coating which prevents them from being broken up in the stomach. In 100 consecutive cases receiving keratin-coated capsules

7 per cent had a vomiting attack; 8 per cent had diarrhea varying from two to eight loose movements and 11 per cent had nausea. For comparison another 100 consecutive cases received the dye in plain gelatin-coated capsules without the keratin treatment and the results were as follows: 12 per cent had vomiting; 12 per cent diarrhea and 15 per cent nausea. In none of the cases was reaction sufficient to prevent persons from appearing the following morning for roentgen examination. The conclusion is reached therefore that so far as reaction is concerned, there is very little difference between the keratin-coated or plain gelatin capsules—in both cases the visualization of the gall-bladder was satisfactory.

Administration of fresh dye in great measure has overcome any unreliability in the roentgen findings following oral administration. The author has now sufficient confidence in the method to use it routinely. It is simple and efficient and can be carried on much the same as investigations on the gastro-intestinal tract with barium meal. The work is difficult; at times it tries the skill of the roentgenologist to the utmost in the making of a gall-bladder examination. Particularly does it require an intelligent patient who can and will suspend respiration during the making of the films. Other things being favorable, the use of a gas tube and compression on the Potter-Bucky diaphragm will give the best results. It is important to make a preliminary examination before the test for the findings may be such as to make diagnosis possible without the use of the dye. Visible gall-bladders must be checked up with the dye.

In normal cases the shadow of the fully distended gall-bladder should appear ten to twelve hours after the dye is given. The starvation continuing, four hours later the shadow should be slightly diminished in size and become more intense, concentration being at its maximum point at this time. As soon as food is given the gall-bladder outline should further diminish in size or completely disappear. The following morning, thirty-six hours after the test, there should be no remaining shadow of the gall-bladder. The author asserts that the technique has been developed to such an extent that it can be absolutely relied upon.

One of the most important values of the Graham test is in the detection of the disturbance of function of the gall-bladder. This disturbance has been recognized by four different variations to the normal sequence of the gallbladder shadow as it appears after oral administration of the dye. These in the order of importance are: (1) absence of shadow; (2) persistence of shadow; (3) faintness of shadow, and (4) late appearance of shadow.

STOLOFF, E. GORDON. Primary infection in tuberculosis. *Am. J. Dis. Child.*, March, 1927, xxxiii, 363–393.

A discussion of the primary infection of tuberculosis in the child is presented with particular reference to the results obtained in a statistical analysis of 6,329 roentgenoscopies made in the out-patient department of the University of Vienna Kinderklinik. A detailed discussion is given of the anatomy of the lungs and of the pulmonary lymph gland system, because these are essential for a proper roentgenologic recognition of the primary infection. Descriptions are also given of the pathologic change and pathogenesis of the primary pulmonary infection, the adjacent pleuritic involvement and the associated disease of the regional lymph glands.

In the beginning, the primary focus may not be recognized as such. In the healed stage it is seen as an area of varying size, usually that of a pea, and of calcium density. It is sharply circumscribed, stellate, circular or oval, with an irregular or smooth margin; it is usually of a homogeneous consistency but may at times be spotted, standing in a clear lung field. Normal hilum glands do not cast a shadow. A shadow in the region of the hilum caused by enlargement or disease of the bronchial lymph gland is not necessarily tuberculous when (1) a primary focus of infection is recognized in the region that it drains; (2) it presents a circumscribed shadow with relatively sharp outline, which shows arching and notching, is of more or less uniformly increased density, and projects laterally into the lung fields; or (3) the hilum region presents a hazy appearance of increased density and is spotted with dense shadows of irregular sharp contour and varying size. Disease of the right side is easier to recognize than disease of the left.

Stripe-like shadows lying between the primary focus and the regional hilum lymph glands, and pleuritic involvement in the region of the primary focus may be present and aid in the diagnosis. The diagnosis of primary tuberculosis is made only when the patient reacts positively to tuberculin. All of the author's patients who revealed a primary tuberculous infection or focus gave positive tuberculin reactions.

The total number of roentgenoscopies was evenly divided between boys and girls. There were 584 single primary foci (9.27 per cent) and 27 multiple foci (9.65 per cent). Localization was lobar, and a comparison was made

with the findings of other observers. The distribution of single primary foci in this series was largely on the right side and in the lower lobes, so that the right lower lobe showed the most foci; next in order were the left lower lobe, the right upper lobe, the left upper lobe and the right middle lobe. Regional disease of the hilum glands on the same side was found in 423 (72.52 per cent) of the cases presenting a single primary focus. Extension from right to left was as frequent as from left to right. Pleuritic involvement was observed in only 30 patients (0.05 per cent).

The total number of children with definitely positive tuberculin reaction was 4,494 (71.02 per cent). There were only 253, or 3.8 per cent who gave definitely negative Pirquet and Mantoux reactions. The discrepancies between these roentgenoscopic and pathologic observations are explained on the basis of physical factors.

WEBB, ROSCOE C. Kienboch's disease of the semilunar bone. *Ann. Surg.*, November, 1926, lxxxiv, 763–765.

According to reports, the prognosis of Kienboch's disease of the semilunar bone is not good. The patients are unable to perform hard work; and a few weeks of splinting does not relieve them. Continued discomfort for several years with the wearing of splints for relief may be the outlook of the patient. The treatment of this condition presents a problem of considerable economic importance. The author describes a case in a railway employee who could not afford to take a prolonged rest unless adequately compensated. It was therefore decided to remove the fragmented bone. This operation was performed and the resulting joint changes allowed the ulna to encroach on the carpal space thus causing a moderate limitation of motion. The patient returned to work after two months and in a short time was able to secure palmar flexion of 153° with complete absence of pain.

The diagnosis was made roentgenographically. The semilunar bone was shown to have undergone a destructive process with fragmentation.

WILENSKY, ABRAHAM O. The pathogenesis of the end results of the lesions of acute osteomyelitis. *Ann. Surg.*, November, 1926, lxxxiv, 651–662.

The problem of osteomyelitis is a complicated one inasmuch as an acute osteomyelitis must necessarily pass through all or many of the stages of a chronic osteomyelitis before its final end result can be determined. It seems that only in a minority of the cases of acute osteomyelitis does a definite end result seem possible of recognition in a definite and apparently permanent healing, which corresponds in its extent and in its characteristics with the formation of a fixation point and the uninterrupted and uncomplicated development of the thrombophlebitic process in one of its typical forms. In all the rest of the cases of acute osteomyelitis the development of the thrombophlebitic process at any given fixation point is modified by the spreading of the thrombosis in the vascular network of the bone. A multitude of modifications may therefore occur, all of which have the tendency towards magnification and distortion of the pathological picture and of its roentgenographic appearances.

The purpose of this communication is the classification of the morphological results of acute osteomyelitis in so far as they involve changes in structural substance and in anatomical form and configuration and in the correlation of these facts with the anatomical and pathological facts previously reported by the author. (In a previous report the author described the roentgenographic appearances of acute osteomyelitis as correlated with the anatomical, pathological and clinical aspects of this disease.) Modifications of the essential anatomical and pathological features are directly due to (1) the spreading characteristics of a thrombophlebitic lesion in osseous tissue: (2) the mutilations of the bone which necessarily accompany any osteotomy; (3) combinations of both of these complicating factors, and (4) exacerbations of infections of endogenous or exogenous origin. A correct appreciation of these complicating factors is of prime importance and may be followed roentgenographically.

WILKIE, D. P. D., and ILLINGWORTH, C. F. W. Cholecystography. *Brit. M. J.*, Apr. 2, 1927, i, 613–614.

Using pure sodium tetraiodophenolphthalein in a dose not exceeding 4 gm., freshly dissolved and injected very slowly, no disturbing toxic symptoms need be feared. Roentgenograms made twelve hours after injection and six hours later, after a meal containing fat, should give reliable evidence as to the functional capacity of the gall-bladder. The method has its limitations and an apparently normal cholecystogram does not exclude the possible presence of a small cholesterin stone or a mild degree of infective cholecystitis. The authors have examined at the University of Edinburgh 158 cases, and in 132 of these the data obtained were controlled by subsequent operation. Of 58 cases showing a normal shadow operation

disclosed a normal gall-bladder in 50. In one case very minute calculi were present in a gall-bladder of normal color and texture. In another case a single cholesterin stone the size of a pea was removed from an apparently healthy viscus. In 3 cases there was definite evidence of mild chronic cholecystitis and in 1 of these a small lipoid papilloma was present. In the remaining 3 cases there was mild catarrhal cholecystitis, and streptococci were grown on cultures made from a portion of the wall.

The gall-bladder shadow was absent in 50 cases and in 44 of these the gall-bladder was grossly diseased. In 6, although no dye entered the gall-bladder, calculi were clearly visible in the films. In 6 cases in spite of the absent shadow a normal gall-bladder was disclosed at operation. These failures are ascribed to faulty management rather than to any inherent weakness of the test.

In 10 cases the gall-bladder was faintly visible but there was obviously defective concentration of the dye. In 3 there were negative areas due to stone. In all of them a very definite cholecystitis was found at operation. There were 11 cases showing shadow of the gall-bladder and calculi, and operation confirmed the roentgen diagnosis in all instances. There were 5 cases showing displaced or distorted gall-bladder shadows. In all, the presence of a swelling below the right costal margin made the diagnosis of a distended gall-bladder a possibility. In 2 cases, the shadow of the gall-bladder was visible below the swelling, which in one instance was a sarcoma and in the other a hydatid of the liver. In 2 cases the gall-bladder shadow was present as a concave shadow lying over and above the swelling. This proved to be a growth of the hepatic flexure of the colon. In the fifth case the shadow lay in front of the swelling which was later shown by pyelography to be a hydronephrosis.

WILLIAMS, E. G. C. The condition called Perthes' disease. *Radiology*, October, 1926, vii, 337–339.

"Perthes' disease" has been applied to the group of nontuberculous or noninflammatory changes in the upper end of the femur that occur before union of the proximal epiphyses. This term and the term "osteochondritis deformans juvenalis" which suggests inflammation where none exists should be discarded according to the author, and the descriptive name "osteochondro-dystrophy-juvenalis" substituted.

Five cases are briefly described in which the usual symptoms of tuberculosis were absent and there was no definite proof of the existence of any inflammatory process in the hip.

A composite case follows: A child under fifteen years, slightly under weight, but apparently healthy and active, develops a tenderness in the hip joint region and a limp. After a few days' rest he appears to be all right and returns to school but has a more severe attack after a few weeks. Examination shows a shortening of the leg. There is no fever, no swelling and very little pain. Roentgen examination shows beginning flattening of the head of the femur with separation of the epiphyses and upper displacement of the neck. There is no evidence of erosion or destruction of bone. The acetabulum is not involved. After a few weeks of rest and immobilization the patient is again able to be out and is apparently well except for a limp due to the shortening. The adult who gives such a history usually presents himself for roentgen examination because of pain from injury to the hip region. Examination shows a short, thickened femoral neck, flattened head and a compensatory flattening of the acetabulum. There is no ankylosis.